SCIENTIFIC AMERICAN

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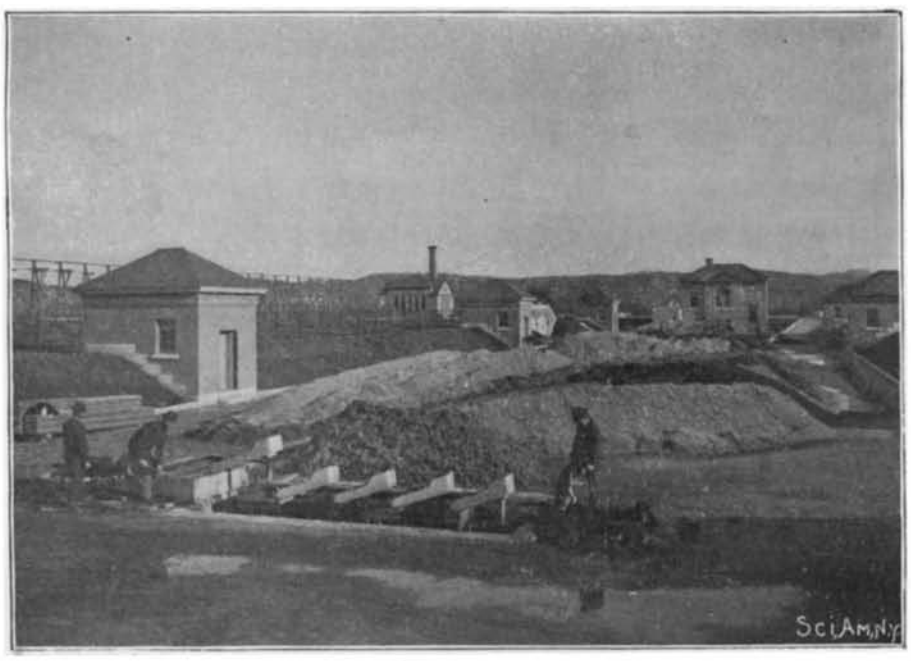
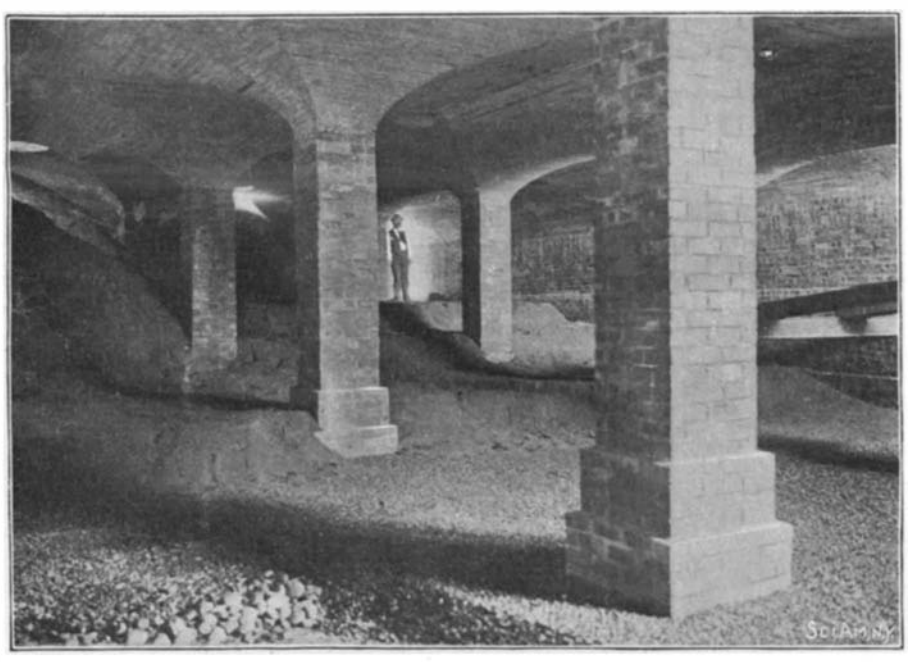
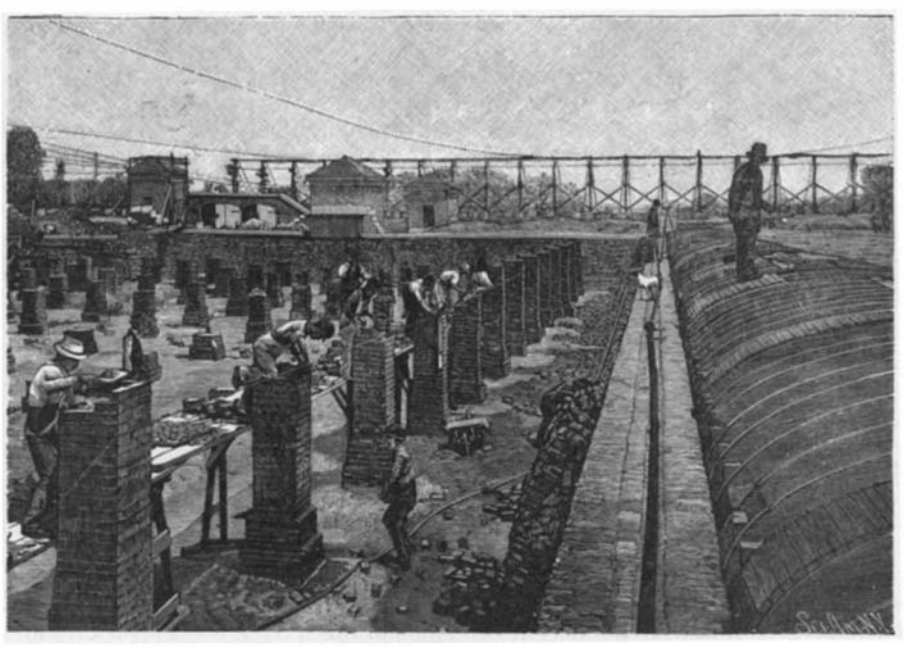


The Sand-Washing Apparatus.

Placing the Groined Concrete Floor of a Filter.

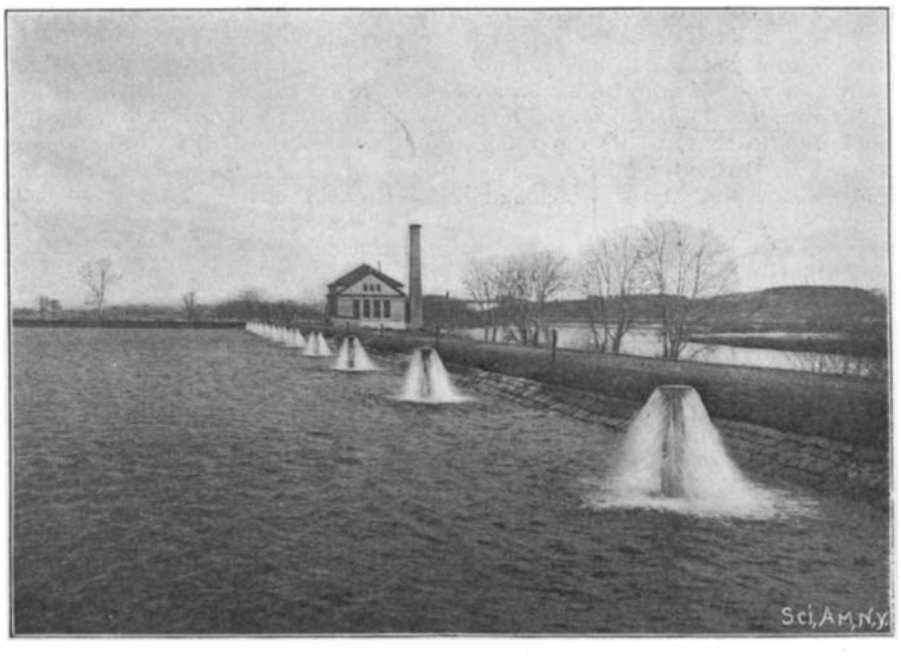


Interior of a Filter, Showing the Layers of Gravel and Sand.



Building the Brick Piers.

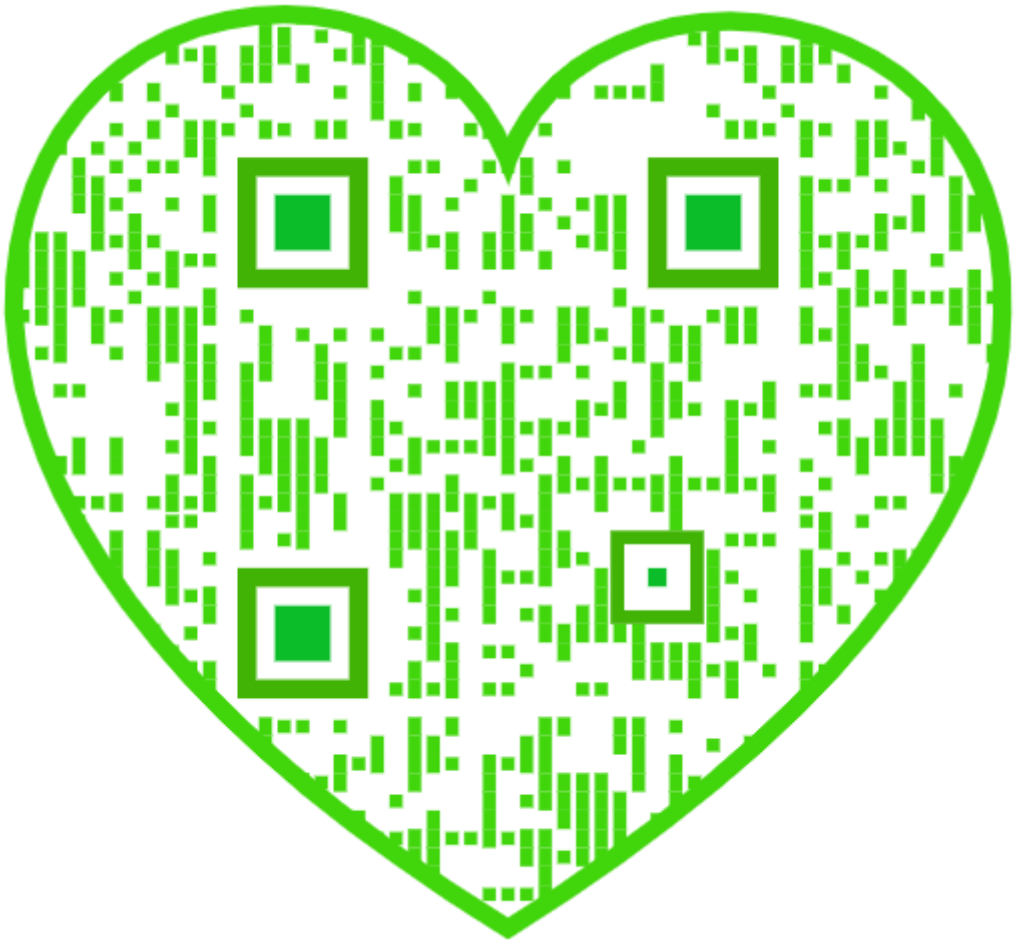
Constructing the Vaulted Roof of Filter.



Sedimentation Basin, Showing Aerating Outlets and Pumping Station.

During the first four months of operation, September to December, 1899, there were seven deaths from Typhoid. For the corresponding period during the nine years ending 1898, the average number of deaths from Typhoid was 24—a reduction of 71 per cent.

FILTRATION PLANT FOR THE CITY OF ALBANY, DESIGNED AND ERECTED FOR THE REMOVAL OF TYPHOID BACTERIA FROM THE WATER SUPPLY.—[See page 182.]



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THE SUPREMACY OF THE MODERN MAGAZINE RIFLE.

When the military attachés who are following the operations of the South African war return from the scene of hostilities, they will bring with them a mass of information which, in its intrinsic value, in the profound effect which it will have upon future military operations, will be without a parallel. Not even the great battles of the Franco-German war, or the heroic defence of Plevna against the battalions of Russia, taught so many lessons as have been spelled out in that great school of instruction upon the broad veldt and amid the kopjes and precipitous mountains of South Africa.

No period in the world's history has witnessed such rapid improvement in the implements of war as has marked the last quarter of a century; and it is due to the initiative of the Boer military advisers, native and European, that there is represented in the present struggle not merely every type of weapon of attack and defence, but the most modern of each type that could be procured in the markets of the world.

The important facts established thus far by the war are the supreme value of the magazine small-bore rifle, especially when used with the spade in defence; the necessity of keeping the artillery thoroughly up to date in respect to its range and mobility; and the increased importance of cavalry in the strategy and especially in the tactics of modern warfare. Although we are dealing just now with the magazine rifle, we would mention, in passing, that though the British artillery in the Natal campaign (with the exception of the more modern naval guns) was of a type brought out only a few years ago, it was so far outranged by the French and German guns of the Boers that the attacking forces were placed at an enormous disadvantage. So, too, the earlier operations of the British were rendered inconclusive for the lack of mounted troops, turning movements being out of the question, and any temporary advantage gained through well-considered maneuvering being more than offset by the remarkable mobility and rapidity of concentration of the burgher mounted troops. It was not until the call for cavalry had been answered that the deadlock was broken, General French and his army of eight thousand cavalry completely turning the tide of war in less than thirty days.

But most significant of all was the revelation of the terrible power of the modern magazine rifle in the hands of a skilled marksman who has a spade and a bandolier of cartridges ready to hand. Its great range, its accuracy, and rapidity of fire, and the invisibility resulting from the use of smokeless powder, enable an entrenched body of men to surround themselves with a murderous zone of fire within which, unless there is ample cover, it is simple suicide for an attacking force to enter. This zone, whose outer fringe extends in open and level country fully two miles toward the enemy, is so wide that the attacking force is sprayed with bullets long before it is close enough to see the entrenchments, to say nothing of the troops that man them. On the other hand the various ranges over which the attack is advancing are staked and measured, enabling the defence to adjust its sights with mathematical precision, the attacking force, during the first mile or more of its advance is, to all intents and purposes, fighting in the dark.

The situation was graphically drawn by Julian Ralph in his now celebrated description of the Modder River battle, where for ten long hours a whole army lay prone upon the earth to escape annihilation from the storm of Mauser bullets that swept the plain. "In engagement after engagement," he writes, "our men have thrown themselves upon the veldt, moved to do so by a hail of bullets around them, and then have fired away for hours at a time at the noise or the flame of the enemy's fire, in trenches which they cannot see." The day of the direct frontal attack, except in cases of absolute necessity, as at San Juan Hill or in the recent storming of Pieter's Hill, is over; and where cavalry or a preponderance of numbers are not present to favor a flanking movement, the attack must henceforth obey the mandate of the magazine rifle, and halt.

The Mauser rifle, which has found such an able exponent of its powers in the Boer soldier, is of a later pattern than that used in the Spanish-American war. It has a caliber of a little over a quarter of an inch (0·276) and fires a bullet which is 1·18 inches long and weighs 11·2 grains, with a muzzle velocity of 2,388 feet per second. At 40 feet from the muzzle the bullet will penetrate 4½ feet of deal. It has an extreme range of 2½ miles, and its trajectory, or curve of flight, is so flat that the space completely swept for infantry is 1,969 feet, and for cavalry 2,297 feet.

Nevertheless, despite its deadly nature, the magazine rifle is a merciful weapon, and paradoxical as it may seem stands second only to the Red Cross as an alleviating agency of the horrors of war. For in the first place the wounds inflicted, unless it hit a vital point, are mere pinpricks compared with the effects of the old large-bore rifles, and in the second place the impossibility of fighting with any hope of success in the open has driven the soldier to cover, with the result that desperate as has been the bravery on both sides in this end-of-the-century struggle, the percentage of losses has been the lightest in the history of warfare.

NEW YORK'S WATER SUPPLY—PRESENT AND FUTURE CAPACITY.

At the present juncture, when the notorious attempt of a private corporation to obtain absolute control of all possible sources of New York's future water supply is under discussion, a review of the present condition and future possibilities of the existing water supply systems of Greater New York will be of special interest. This, the greatest of all important questions of municipal administration, should receive the early and undivided attention of the three millions of inhabitants whose health and comfort it so vitally affects, and it is the duty of every citizen in the presence of such a momentous problem as has been raised by the proposed Ramapo scheme to acquaint himself, at least in a general way, both with the present condition and the future possibilities of the city's water supply.

In making the present necessarily brief review of the question, we cannot do better than consider separately the water supply of each of the five boroughs which compose the consolidated New York city of to-day. Of these, by far the most important are the Boroughs of Manhattan and the Bronx, whose sources of water supply are topographically closely related. The two million inhabitants of these boroughs depend for their supply upon three watersheds, those of the Croton, the Bronx, and the Byram Rivers. The drainage area of the Croton River and its tributaries above the Croton Dam is 338 square miles. The records of the past thirty-three years show an average annual rainfall of 48 inches with a maximum of 63·5 inches in 1888, and a minimum of 38·6 inches in 1895. The average total annual supply from the Croton watershed, supposing the whole amount to be utilized, is about 147,000,000,000 gallons. Prior to 1870 there was no reserve supply of this great total held in storage except in the small lake formed by the Croton Dam, from which the Old Aqueduct drew its water. Subsequently to that date various storage reservoirs have been formed across the different streams in the watershed, until at present there are eight in active use, with the total capacity of 40,500,000,000 gallons. Below these, two or three miles from the mouth of the river, is the great Croton Dam, to be completed in 1902, which will provide an additional storage capacity of 25,000,000,000 gallons. In the operation of the reservoirs the policy is to keep them full to the lips of the dams, only drawing upon the water thus stored on such days as the demands of the city exceed the flow of the Croton River. As the minimum average daily flow of the Croton River, in the driest of the last thirty-three years, was 250,000,000 gallons, and the daily consumption of water by the city is 98,000,000 gallons, it will be seen that there is an ample margin of supply over the demand. In the last report of the Department of Water Supply of the City of New York, it was stated that the department is prepared, in case of necessity, to deliver a daily water supply of 200,000,000 gallons for two hundred consecutive days, irrespective of the natural flow of the Croton River.

The supply of water for the Borough of the Bronx is derived from the Bronx River with a drainage area of 13⅔ square miles, and the Byram River with a drainage area of 8⅓ square miles, and the daily supply at present amounts to 14,000,000,000 per day from the former and 19,000,000 gallons per day from the Byram River. The water is conveyed to the city from the Croton watersheds by means of two aqueducts—the Old Aqueduct, with a capacity of 80,000,000 gallons per day, and the New Aqueduct, with a capacity of 300,000,000 gallons per day. The Bronx and the Byram Rivers conduits deliver 20,000,000 gallons per day, bringing up the total daily conduit capacity to 400,000,000 gallons.

The Borough of Brooklyn is supplied with water on an entirely different system from that in use for Manhattan and the Bronx, the difference being due to the topography of the watersheds and the intervening territory through which the supply is conveyed to the distributing systems. The New York supply flows by gravity from the source to the distributing mains, while only a portion of the Brooklyn system consists of a gravity supply, a large percentage being pumped into the conduits from wells and from bodies of water which lie below the level of the conduits. With a few exceptions the Borough of Brooklyn derives its entire water supply from a watershed within the boundaries of the county in the present Borough of Queens, which embraces the southerly slope of the central ridge of Long Island and the plains which extend south of it to the shores of Jamaica and Hempstead Bays. Its total area is 150 square miles. Within this area are located seventeen separate ponds or reservoirs for the storage of water, which have a total area of 491 acres and a total storage capacity of 1,283,000,000 gallons. During the last twelve years it has been necessary to supplement this water supply by means of wells and pumping plants, and these have grown so rapidly that at present there are sixteen stations which draw water from 963 wells of from 2 to 8 inches diameter. The total daily capacity of these wells is 57,500,000 gallons.

The avarage daily Brooklyn supply for the year 1898 was 93,573,500 gallons, while 10,500,000 gallons were received from private water companies of which the Long Island Water Company and the Flatbush Water Company are the most important. This makes a total supply of 104,073,500 gallons for a population of 1,179,100 souls, at the per capita consumption of 88·3 gallons.

Comparing now the water supply of Brooklyn with that of Manhattan and the Bronx, we find that in the latter borough the daily use of water rose to 243,000,000 gallons for a population of slightly over 2,000,000, or a consumption per capita per day of 121 gallons. To quote the words of the Department of Water Supply in their Annual Report, the Brooklyn rate of 88·3 gallons per capita "is very liberal and ample for all purpose of comfort, health and safety" the per capita consumption of 121 gallons of Manhattan and the Bronx being considered as "altogether extravagant and unnecessary," the department being of the opinion that "enormous quantities are carelessly and wantonly wasted without any possible benefit in any direction."

Manhattan and the Bronx, however, as we have seen, have a liberal margin to go upon, the average annual supply being 147,000,000,000 gallons, as against a consumption for the year 1899 of 92,000,000,000. In the Borough of Brooklyn, on the contrary, the per capita rate of consumption must necessarily be diminished, since the population will continue to grow whether extensions of the water system are made or not. The needs of the immediate future can be met by sinking additional wells at the existing pumping stations, by an increase in the capacity of pumping machinery, and by an enlargement of the conduits. The time, however, is not far distant when it will be necessary to acquire additional watershed area to meet the future growth of the borough.

The Borough of Queens is supplied from four public water plants with a combined daily capacity of 3,347,000 gallons, and about 1,500,000 gallons are supplied under a contract with the Citizens' Water Supply Company. The department is of the opinion that the anticipated growth of this borough will demand large additions to the present capacity of the water supply, proportionate and incident to the necessities for increasing the Brooklyn supply. As any additional supply for the Borough of Brooklyn will have to pass through the Borough of Queens, it will be advantageous to treat the two systems as one in any scheme of enlargement.

The problem in the Borough of Richmond, like that in the Borough of Queens, is, of course, relatively insignificant compared with that of the Bronx, Manhattan, and Brooklyn. There is one small public water plant at Tottenville with 1,000,000 gallons daily capacity. There are also two private water companies which, combined, are pumping a daily supply of 6,500,000 gallons. The problem of the future supply as regards this borough is not to be considered as pressing.

In summing up then, we find that Manhattan and the Bronx, with a daily per capita consumption greater probably than that of any city in the world, have still at command an annual surplus of supply over consumption of 67,000,000 gallons; while the Boroughs of Brooklyn and Queens are practically without reserve at the present consumption per capita of 83·3 gallons. No immediate anxiety need be felt for the future water supply of the Borough of Richmond. In a future issue we shall consider the notorious Ramapo scheme and its bearing upon the interests of the second greatest city in the world.

AMERICAN EXPERIMENT STATIONS AT THE PARIS EXPOSITION.

Among the many economic exhibitions that our government will make at Paris especial interest attaches to that of the United States Experiment Stations, from the fact that it will show the great progress made by them since the Paris Exposition of 1889, when the stations made only a small showing, as they were just beginning active operations under the Hatch Act. The ar-

rangement and shipment of this exhibit, which has just been perfected was in charge of Dr. W. H. Evans, of the Office of Experiment Stations, at Washington, who also supervised the preparation of the charts and photographs exhibit, and will go to Paris to install the exhibit.

At their recent meeting in Minneapolis, in 1897, the Association of American Agricultural Colleges and Experiment Stations, adopted a resolution in favor of a co-operative experiment station exhibit at the Paris Exposition. A committee was placed in charge of the matter and the stations were invited to contribute materials and charts illustrating special features of their work and results, original pieces of apparatus, models, designs, etc. As prepared, this material was shipped to Dr. True, Director of the Office of Experiment Stations, in Washington, who made a collection of photographs and publications of the stations, a monograph on the experiment station enterprise of this country, and looked after the temporary installation of the exhibit and its final shipment.

This commendably comprehensive exhibit contains the following, among other features:

A photograph exhibit of about 750 selected pictures of station buildings, grounds, laboratories, apparatus, experimental plants, herds, and other features, and a collection of photographs of the station directors and staff members, mounted in groups on sheets of heavy cardboard, 22 by 28 inches, is displayed in portfolios of twenty-four each.

A series of root cages from the North Dakota station, shows the formation of the roots of maize, wheat, flax, and brome grass; models of sweet potatoes, peppers, apples, and plums exhibited by the Iowa and Minnesota stations illustrate varietal differences; and an exhibit of salt bush from the California station show species of proved value for strongly alkaline soils. Electrical devices for determining the salt content, temperature, and moisture content, and a series of samples illustrating the typical agricultural soils of the United States, represent the work of the Division of Soils of the United States Department of Agriculture. The California station sent six typical soils of that State, and specimens showing the results of mechanical analyses of each type of soil, and Hilgards' soil elutriator for mechanical analysis.

Animal and vegetable fats, chemically pure proteids separated from the seeds of various plants, a collection of one hundred weed seeds, an insect cabinet, a gas desiccator for drying hydrogen gas used in moisture determination, models of round and stave silos an apparatus for the rapid cooling of wines, a pressure apparatus for experiments with solution under very high pressure, a model of the Atwater-Rosa respiration calorimeter and a full-sized bomb calorimeter are included in the exhibit.

California furnishes an olive exhibit, of fifty samples of olive oils and over two hundred samples of olive pits used in the classification of varieties of olives; and Alabama sends a collection of mounted specimens of cotton of seventy-two selected and cross-bred varieties.

Original apparatus for investigations in vegetable physiology are shown, including an auxanometer for experimental work on the rate of plant growth; an apparatus for determining the rate of transpiration of plants, from the West Virginia station; and a centrifuge, used to study the effect of gravity and centrifugal force upon germinating seeds, from the Indiana station.

A principal exhibit is that of the dairy industry, including cheese models from the New York State station, showing the effect of the fat content of the milk on the size of cheese produced; a collection of forty-eight cultures of dairy bacteria, from Connecticut; the original Babcock milk tester, two more modern forms of the apparatus for hand and power operation, with a complete collection of the apparatus used in the Babcock test. The Scovell milk-sampling tube, Wisconsin curd test, Marshall rennet test, acid bottles, and other minor apparatus are also included.

Irrigation, a subject to which this country has given much profitable attention, is represented by an exhibit of apparatus and models, containing a hydrophore to determine the amount of silt carried by water; a nilometer, used to measure the amount of water passing through streams, flumes, and ditches; a current meter, water register, etc.

The enormous literature of the experiment station work, greater in extent than that of all other countries combined, is represented by a large number of charts and enlarged pictures showing the result of experiment station work on a wide range of subjects, a complete set of bound bulletins and reports numbering several hundred volumes, and many miscellaneous publications of the stations, together with over one hundred books on agricultural subjects written by station officers.

Even far away Hawaii comes in for its share of the honors, with an exhibit of samples of rocks, lavas, lava products, soils, varieties of sugar cane, and samples of agricultural products, such as coffee, rice, and sugar. In the breadth of its conception and its complete setting forth of the marvelous results attained in this country in one decade this exhibit is destined to be a revelation to students and economists from other lands.

AN ADMIRALTY BOARD FOR THE NAVY.

It is announced that in a few days there will be promulgated an order, signed by Secretary Long, which will create a board of officers of high rank, corresponding to the General Staff or Admiralty Board of European naval powers, with Admiral Dewey at its head. It is stated that this board will constitute a permanent strategic committee, whose duty it will be to maintain the navy at a high standard of efficiency, to arrange for home defence, and for the operation of our fleets, and in times of war to advise the government as to the proper strategy to be employed. The General Staff is to consist of six ex-officio members, all of them naval officers. At the head of it will be the Admiral of the navy. It will also include the Chief of the Bureau of Navigation, the Chief Intelligence Officer of the navy and his principal assistant, and the President of the War College and his principal assistant; the three other members are to be officers of the grade of a commander or higher.

The General Staff must meet in Washington once a month, and twice in the year it must be in session for at least a week. It will be kept fully informed as to naval matters abroad, and it will be concerned with the considerations of plans to be carried out in the event of war with certain foreign nations. The General Staff is also expected to advise the Secretary of the Navy in matters pertaining to our naval establishment. While it will not supersede the Board of Construction, it will act in general along parallel lines and will consider and advise upon subjects dealt with by that Board. Our readers will see in the organization of the General Staff, the perpetuation in many respects of the functions of the Naval Ward Board of the late Spanish-American war. That, however, was a temporary organization; whereas the General Staff, by reason of its perfect familiarity with and study of possible problems which would arise in a naval war, would be in every way better furnished for the emergency than its predecessor.

THE NEW NAVAL PROGRAMME.

The most satisfactory feature in the naval programme agreed upon by the House Committee on Naval Affairs, is that the secretary is authorized to contract for armor plate at $545 a ton, for the purpose of completing the ships, the construction of which has been delayed by the unfortunate armor plate controversy. The amount required is 7,400 tons. It is very gratifying to see that there was a majority in the committee which was in agreement with the government experts in believing that it would be foolish policy for the government to undertake the construction of an armor plant, whose cost would not be less than $5,000,000. It was urged by these gentlemen that unless provision were made for supplying armor to the ships which are now awaiting it, it would be foolish to enter upon the construction of new ships, as an unarmored battleship was for purposes of active service worse than useless.

The committee is in favor of the construction of two new battleships and three armored cruisers of about the same size as those authorized in the naval programme of last year, and three protected cruisers. The battleships will be 13,000 to 14,000 tons and the armored cruisers about 1,000 tons less in displacement. The designs, as far as they were made known last year, appeared to be admirable in every respect, and our only regret is that the new programme does not call for twice as many of these ships as have been recommended. Of protected cruisers we can only say that we sincerely hope they will not be a repetition of the very inferior design represented by the "Denver" class. Sixteen-knot unarmored vessels may commend themselves as a profit-earning contract to the contractor, but for the practical purposes of a modern navy they will prove to be of very limited value.

The question of sheathing the new ships is left to the discretion of the Secretary of the Navy, and the important question of the construction of ships in the Government navy yards to which we made lengthy references in our last issue, was passed over. As the law requires the letting of contracts for new vessels to the lowest bidder, the matter as far as the House Committee on Naval Affairs is concerned, stands where it was. It will be necessary for the Secretary of the Navy to obtain specific authority before he can authorize a warship's construction in our navy yards. It will be remembered that the department was in favor of the construction of several gunboats, but owing largely to the recommendations of Admiral Dewey, who is opposed to the construction of gunboats and in favor of the construction of more battleships, the committee compromised the matter by reporting in favor of the battleships, as stated above, although more vessels of that type have not been recommended by the Department.

TONING LANTERN SLIDES AND BROMIDE PRINTS BY FERROCYANIDE OF COPPER.

Although the colors, various shades of black, produced by the ordinary development of lantern slides and bromide prints are so far satisfactory, it is apt to become monotonous when any considerable number is exhibited; and hence the desire, by some method of toning, to secure various shades of other and especially warmer colors.

Success in this direction has generally come through the use of some of the rarer metals, gold platinum iridium, uranium etc., although there always seems to have been a feeling that copper, itself one of the colored metals, should lend itself to a cheaper and probably better method than either of them.

It was easy enough to make the insoluble ferricyanide of copper, but the problem was to find a solvent by which it could be made and kept in solution so that the silver of the image could reduce it to an insoluble ferrocyanide, the coloring body, without at the same time staining the paper or acting on the gelatine.

And this has at last been accomplished. Mr. W. B. Ferguson, an accomplished chemist as well as a Q. C., after several years' experimenting, found the desired solvent in neutral potassic citrate, neutral citrate of potass, and at a recent meeting of the Royal Photographic Society, traced the devious paths through which he had been led to the desirable result; giving practical illustration of the ease by which prints could be toned to various colors from deep black to bright cherry red, the only modification being the time they were left in the solution; and showing lantern slides in all these colors. Through these paths it is needless to follow him, but it may be said at once that the discussion that followed showed that in the opinion of those present the method was the best, as it certainly is the cheapest that had yet been proposed.

The material, potassium citrate, copper sulphate, and potassium ferricyanide, is first made up into ten per cent solutions in which state they will keep indefintely, but should not be mixed until they are about to be used. The following is the formula, and the solutions must be mixed in the order prescribed:

Copper sulphate (10 per cent solution)	75 c.c.m.
Potassium citrate (neutral)	570 c.c.m.
Potassium ferricyanide	66 c.c.m.

Parts may be substituted for cubic centimeters by those who may not have metric measures, and if half drachms are taken for parts the result will be very close to the quantity prescribed.

To those having a doubt as to how best to set about making ten per cent solutions it will be sufficient to say, that as the dealers ounce contains 437·5 grains, all that is necessary to make that quantity into a ten per cent solution is to mark a bottle at the point reached by nine ounces and fifty minims of water, put the ounce into the bottle and fill with water to that point. Each measured minim of such a solution will contain one grain of the substance in solution. With liquids instead of solids, the bottle should be marked at the ten-ounce point, a measured ounce placed in the bottle and the bottle filled up to the mark with water.

In toning with this solution of cupric ferricyanide in potassium citrate, the soluble ferri salt is supposed to be by the action of silver of the image reduced to the insoluble ferro, which is deposited in situ; and being a bright red, the various shades of color arise from the black of the original image showing less and less through that red until it ceases to show at all. The method of toning is simplicity itself, all that is necessary being to place the developed fixed and washed slide or print in the solution and when the desired color has been reached, to wash in a few changes of water. After use the solution is thrown away.

DEATH OF A NOTED INVENTOR.

James G. Smith one of the pioneers of the telegraph died on March 13. He is best known for his invention in conjunction with Joseph B. Stearns of the duplex system of telegraphy. He was one of the first telegraph operators to receive by sound. He was born in New Hampshire in 1836. He served his apprenticeship under Joseph B. Stearns, and while in the office at Durham N. H., he took off by sound a three thousand word foreign news despatch for one of the local newspapers; this feat brought him considerable fame. He started working the first repeaters in Utica, Cleveland, Louisville, and Pittsburg and during the Civil War was in charge of all dispatches going between New York and the South, and was virtually a government official. During the draft riots when his own telegraph lines were torn down, Mr. Smith was sent out with a force of picked men to keep the lines clear so that communication with Boston would not be cut off. He was connected with a large number of various telegraph companies and the duplex system which he invented in collaboration with Mr. Stearns was used on the line between Boston and New York, the company being known as the Franklin Company. Since 1885, Mr. Smith turned his attention to telephones entirely and the last days of his life were spent in working up patents and inventions in telephones.

THE PRINCESS CHRISTIAN HOSPITAL TRAIN FOR SOUTH AFRICA.

BY H. J. SHEPSTONE.

The military hospital train, which was recently built by the Birmingham Carriage and Wagon Company, Limited, of Birmingham, England, was in many ways a remarkable piece of engineering, and interesting not only on account of the fact that it is the first really efficient hospital train ever built in England, but because of its superior finish and the quick time in which it was built.

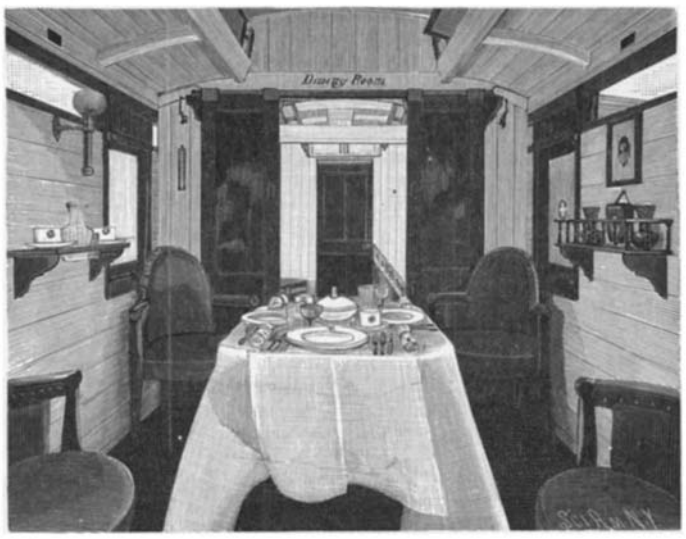
Hitherto it has been the practice of the British government to utilize ordinary carriages when the necessity has arisen for conveying large bodies of wounded men from place to place. This has been done by clearing the carriages of all internal fittings and fixing an iron frame across the compartment on which stretchers could comfortably be placed. Admirable as this scheme undoubtedly is in cases of emergency, it is, nevertheless, a poor makeshift compared with the admirably-equipped hospital trains which are to be found in both the German and Russian armies. And it is probably owing to the fact that the South African lines are of such narrow gage, viz., 3 feet 6 inches, that the Red Cross Society decided to build a specially-constructed hospital train for service in South Africa. The society was prepared to purchase and adapt coaches from makers who were constructing carriages for the South African railways, but not being able to obtain them quickly enough, the committee determined to have a train specially built and equipped for hospital work.

The train itself consists of seven coaches or carriages each 36 feet in length. They run on ordinary bogies and are fitted throughout with the vacuum brake. They compare very favorably with the ordinary English carriage in dimensions, being 8 feet wide and 8 feet high, inside measurement, though it may be added that the latter are designed for a gage of 4 feet 8½ inches, compared with the 3-foot 6-inch gage in South Africa. In the matter of ventilation, the hot climate of South Africa has been taken into consideration, and broad, wide steps have been fitted to the train, so that access to the carriages is made easy when no platform is available. The doors of the carriages, too, have been built specially wide.

The first two coaches are each sub-divided into three compartments. The first compartment in the former coach has been ingeniously fitted with cupboards for storing linen, bandages, and the necessary paraphernalia essential to a fully-equipped traveling hospital. At the extreme end of the compartment is a large chest for soiled linen, which is lined with zinc and well ventilated. The second compartment contains beds for two wounded or invalided officers, and is nicely furnished. These beds, however, are so designed that they act the double purpose of seats by day and beds by night. The third compartment is similarly fitted for two lady nurses.

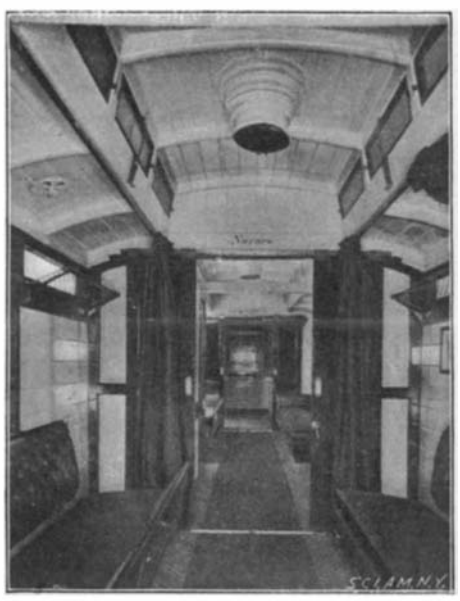
The second coach is probably the most interesting, the three compartments into which it is divided comprising a doctor's room, dining-room, and surgery. The last is equipped with shelves and racks for holding bottles and glasses, and so arranged that there is no fear of there being broken through the movement of the train. Along one side of this compartment runs a wide bench for dispensing purposes, while sufficient space is left for an operating table.

The next four coaches are known as the wards, and are all fitted alike. Each coach contains twenty-two beds, eighteen for invalids and four for the orderlies. The arrangement of these beds is both ingenious and unique. They are ranged on either side of the coaches in three tiers, leaving a passageway, 2 feet 6 inches in width, down the center of the coach. The beds themselves consist of a light iron frame, on which a hair mattress is placed. These frames rest on iron brackets securely fixed to the sides of the compartments at the requisite height. When it is desired to place a patient on a bed, the frame with its mattress is taken down, carried to the ambulance, and the invalid laid upon it. The bed is then lifted back into the carriage and raised to the required level by an ingenious arrangement of pulleys fixed to the roof. One man can easily raise the bed with its precious burden by the aid of the pulleys, leaving the other bearer free to guide it to its proper position.



THE DINING-ROOM.

The first compartment of the last coach is an extremely up-to-date kitchen with a 4-foot 6-inch cooking range. Adjoining this is the compartment for the guard, and beyond that is the larder or pantry. Every available corner from one end of the train to the other has been called into requisition. Lockers, drawers, shelves, and racks have been constructed in the most wonderful fashion in every conceivable nook and corner. Even the roof, of some of the coaches have been utilized and turned into natty little cupboards. Every coach can boast of a lavatory and closet, as well as a small stove for heating a kettle of water when required. The interior of the coaches is most beautifully finished in white enamel, which gives it a cheerful appearance and the impression of plenty of room. The train is built on the corridor principle, and one can walk right through its whole length, passing from ward to ward, for a distance of over two hundred feet.

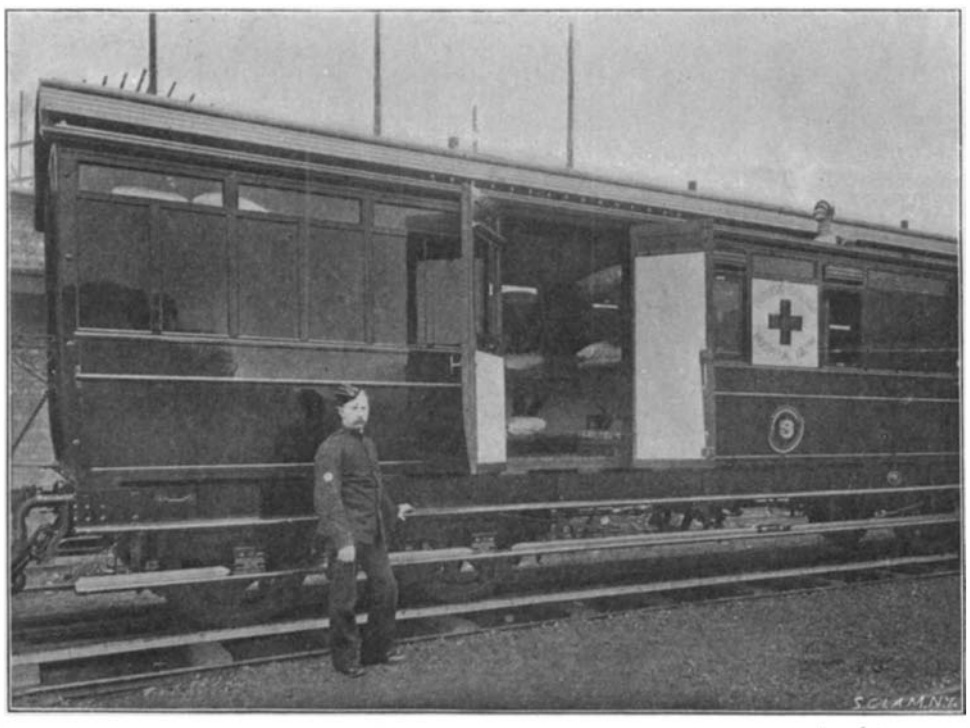


NURSES' COMPARTMENT.

THE KITCHEN.

The train is known as the Princess Christian Hospital Train, and is so named for the following reason: The train has been constructed to the order of the British Central Red Cross Committee, who purchased it from their funds. The largest amount was contributed by the inhabitants of Windsor, who expressed the desire that the train should be named after Her Royal Highness, and as the balance which was needed was supplied by her, the request was naturally acceeded to. It may interest many to know that the cost of this unique hospital on wheels was only £7,000, or about $35,000.

The whole seven coaches were ready for shipment within ten weeks after the contract was signed. The contractors in the present instance, the Military Equipment Company, Limited, of Pall Mall, London, are undoubtedly to be congratulated on the able manner in which they performed their work. Their agreement with the Red Cross Society was to supply a train of seven coaches in twelve weeks. The Birmingham Railway Carriage and Wagon Company, Limited, who undertook to build and fit up the train, entered heartily into the affair, while of course the skill and knowledge of the medical department was readily forthcoming the moment it was needed to best settle any little detail as to the interior fittings of the coaches, etc. We may also add that before the train left for its mission of mercy in South Africa it was inspected by Her Royal Highness, Princess Christian, who expressed herself highly pleased with the able manner in which the whole arrangement had been carried out. The coaches are built in sections, and are now on their way to South Africa packed in 157 cases, having a total weight of 167 tons. Each package is numbered and marked to facilitate the work of reconstruction, and it is estimated that the train will be ready for use three days after arrival.



BRITISH RED CROSS HOSPITAL TRAIN FOR USE IN SOUTH AFRICA.

The Adulteration of Food Products.

For a considerable time the Senate Committee on Manufactures has had under way an investigation into the extent to which food preparations are made the subject of adulteration, and their report has been submitted to the Senate. The evidence seems to show that our peppers, cinnamon, cloves and spices, generally, including ginger and mustard are adulterated, the amount depending upon the man ordering the article; in some cases it reaches sixty per cent. Of course, in the case of butter, cheese, and flour, the practice of fraud can be more easily detected than in the falsification of spice. The committee has taken the ground that the sale of deleterious and unhealthy food products should be prohibited and where the adulteration is harmless and the goods cheapened, they should be marked for what they are. One method of dealing with the difficulty contemplates putting important food products under the internal revenue law, as has been done with flour, filled cheese and butter. It is said that the poor flour bill has absolutely prevented the sale of adulterated flour and has increased, according to Bradstreet's, the sale of American flour 25 per cent in other countries. Another plan contemplates the establishment of a board which shall fix the standards for food, drink and drugs. Of course, the same rule should apply to foreigners who manufacture goods to be sold in this country.

MARCONI thinks that the present limit of 86 miles for wireless telegraphy will shortly be raised to 150 miles.

AN ELECTRIC ALARM TRY-COCK FOR STEAM BOILERS.

A very ingenious arrangement for sounding an electric alarm when the water in the boiler has fallen below a safe level, has been introduced by the Electric Boiler Protection Company, of 9-13 Maiden Lane, Manhattan, New York city. The device is a safeguard against explosions or injuries to any steam boiler made.

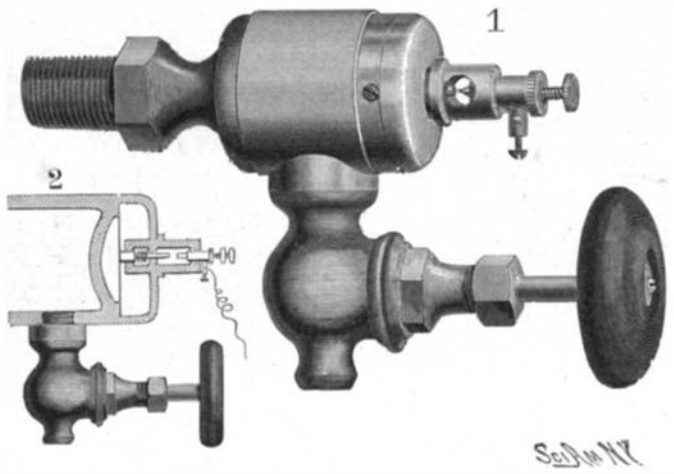
Fig. 1 represents the apparatus in perspective. Fig. 2 is a partial section.

The lower try-cock is provided with an expansion chamber, composed of a concave wall and a diaphragm hermetically sealed together. The diaphragm is designed to engage a spring-pressed plunger carrying a contact point, which, when it touches the opposite contact point of binding post, completes the electric circuit.

When the water in the boiler is above the level of the try-cock, the parts will be in the position shown in Fig. 2. But when the water in the boiler sinks below the normal level, steam enters the try-cock, heats the air in the expansion chamber, forces the diaphragm against the plunger, which in turn completes the circuit as it touches the contact carried by the binding post. The alarm sounded will immediately inform the attendant engineer that the water in his boiler has sunk dangerously low. The cooling of the air in the expansion chamber returns the parts to their normal positions.

As many alarms as may be desired can be disposed about the building. A group or nest of boilers protected in the manner described, may be wired to an annunciator, thereby showing which boiler needs attention. Switches can be provided to cut off the alarm, until the cocks cool off, thus saving battery current and the unnecessary noise of incessantly ringing bells.

The device takes the place of the lower try-cock, and can be attached to any boiler in a few moments.



ELECTRIC ALARM TRY-COCK FOR STEAM BOILERS.

THE CREEPING OF RAILS ON THE EADS BRIDGE, ST. LOUIS.

In response to our inquiry as to the exact amount of rail creeping on the Eads Bridge and the means adopted to accommodate it, we have received the following very interesting letter from Mr. N. W. Eayrs, the superintendent of structure, who replies as follows :

"I have your letter of the 8th inst., making inquiry about the amount of rail creeping on the Eads Bridge. This movement of the rails occurs not only upon the spans, but also upon the east approach trestle; the movement on the latter is, however, considerably less now than it was before the trestle was reconstructed. The original structure was very light, and in consequence there was an unusual amount of elasticity in the floor. The creeping occurs always in the direction of the traffic; that is to say, the west-bound track runs west and the east-bound track east, and varies in amount with the variation in tonnage passing over the rails. The movement is dependent on the elasticity of the track supports; with increased stiffness in the floor system the amount of rail movement is decreased; in fact, several years ago a portion of the east approach trestle, a wooden structure about 1,000 feet in length, was filled and the track put on the ground. In this portion the rail movement almost entirely disappeared. As corroborating my opinion that the rail movement is caused by the elasticity of the road-bed, I may mention a section of track on the Canadian Pacific, which was laid on a soft marsh. If my memory serves me rightly as to the amount, this section of track moved two feet under a single train.

In the month, April 15 to May 15, 1899, some measurements of the movement were made at two points, one on the center span of Eads Bridge, and one at the west end of a 5° 43′ curve on the east approach. The movements were as follows :

	Eastbound Track.		Westbound Track.	
	North Rail.	South Rail.	North Rail.	South Bail.
Center span....	17 ft. 10½ in.	19 ft. 4½ in.	19 ft. 9⅝ in.	12 ft. 7¼ in.
East approach..	25 " 9 "	47 " 7 "	33 " ½ "	34 " 2¼ "

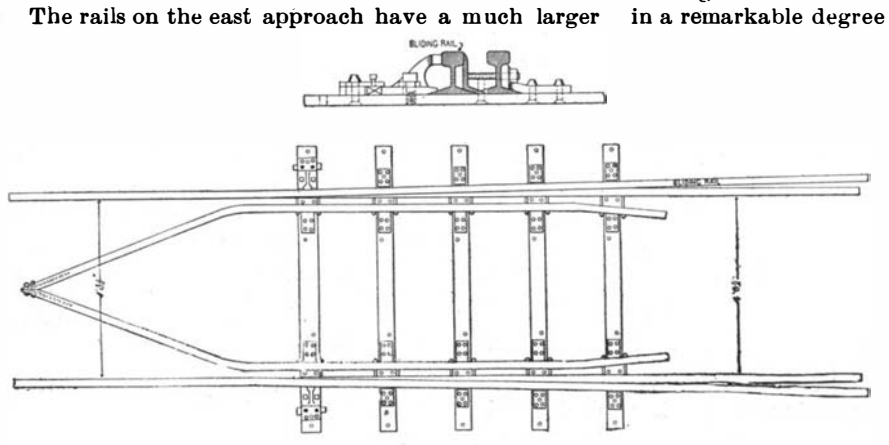
The rails on the east approach have a much larger run between creeping points than on the bridge, which accounts for the increased rail movement.

Attempts were made at one time to check this movement, but it was found inadvisable to continue the experiment, as the strain on the fastenings was sufficient to tear fish-plates in two, or to shear off a ⅞-inch track bolt. Accordingly the track was kept continuous by inserting pieces of rail of various lengths at the end where the movement commenced, and removing corresponding pieces at the other end. At either end of the bridge there are cross-overs which of course must be kept in line; at these points, therefore, the rail movement required control; there are also two points on the east approach on each track which require protection. Accordingly there are eight "creeping plates" as we call them, in the track.

In order to avoid the necessity of keeping a supply of pieces of rail from 2 inches long to 30 feet long at each place, and to dispense with the necessity of keeping a trackman to watch these places, we put in, about fifteen years ago, a device which is shown on the accompanying drawing. This device consists of a pair of switch points, rigidly held to gage by forming part of an iron frame which is bolted to the ties. The main rails of the track which is ahead of the device—that is, in the direction of the traffic—extend outside of the switch points. A full rail is coupled on to the main rail, which, in the case of a trailing point, drags the rail through the jaws, or, in the case af facing points, shoves it through the jaws. In the former case, when the rail has nearly passed through, a new rail is coupled on, and in the latter case the rail is uncoupled as soon as it has passed through the creeper (or the "Irishman" as the trackmen call it, since it takes the place of the Irishman formerly employed). The rail which has been shoved through the creeping plate and has been taken off, is carried across to the opposite track to be used to feed into the creeping plate, and begins to travel back again.

The force impelling the rail is so strong that it will drive a straight 70-pound steel rail through a 5° 43′ curve, curving the rail during the passage and straightening it again after the rail comes through.

The movement on the spans can probably never be entirely overcome, as the deformation of the arched ribs under the action of a moving load intensifies the action of the elasticity of the track."



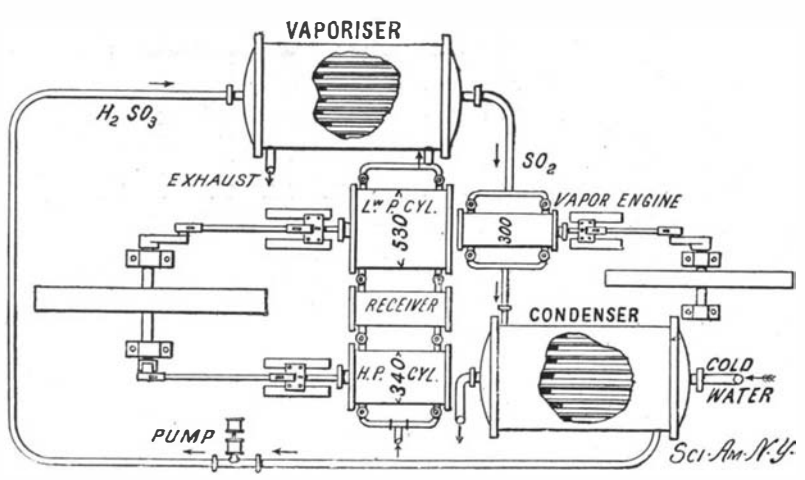
"THE IRISHMAN."
Device used at each end of the Eads Bridge to switch the creeping rails out of the track, and introduce the new rails.

A NOVEL FORM OF STEAM ENGINES.

The recent centennial anniversary of the Royal Technical High School at Charlottenburg was made the occasion of several important announcements concerning the work of that institution, which embodies in a remarkable degree the advanced technical science which has done so much to push Germany forward into the front rank of manufacturing nations. Among these is the paper of Prof. E. Josse, head of the mechanical laboratory, in which are described with elaborate detail the results of his experiments with an original and highly interesting process for increasing the efficiency of steam engines by utilizing the heat of the exhaust steam for evaporating another liquid having a lower boiling point than water. This paper is made the subject of a special report by Consul-General Frank H. Mason and we take pleasure in publishing an abstract of his paper.

The process is the joint discovery of Mr. G. Behrend, a Hamburg engineer, and Dr. Zimmermann, of Ludwigshafen.

It is plain that, with all progress which has hitherto been made in steam engine practice through higher pressures, superheated steam, economical cut-offs, or successive cylinders, there is always an important and inevitable loss of heat energy when the steam, having done its work, is discharged into the open air or changed back to water by contact with cold water in a condenser. When the exhaust is into the open air, the steam has a temperature of about 100° Celsius (212° F.); when it passes into a condenser, the steam has a temperature of 60° to 70° Celsius (140° to 160° F.), according to the vacuum. The corresponding latent heat of steam, given up upon change of form from steam to hot water, has hitherto run to waste in the condensing or cooling water, or in the air. Messrs. Behrend and Zimmermann attacked the problem of utilizing this wasted caloric by employing it to create a new supply of steam by evaporating some liquid which has a lower boiling point than water, and for this purpose they chose, after many experiments, sulphurous acid (H_2SO_3), which is not only cheap and easily obtained, but has the further advantage of a viscous consistency and lubricates the inner working surfaces of the machinery without corroding them. Their demonstrations, although not practically conclusive, were so promising that Prof. Josse, as a technical authority on this subject, took up the problem, and, after several months of highly satisfactory laboratory experiment, caused to be constructed and connected with an ordinary working steam engine of the compound type an additional condenser and auxiliary engine, the power of which could be exactly measured. The whole working apparatus is shown in the engraving herewith submitted, and the technical details will be explained by the drawing, and may be thus described.



NEW TYPE OF STEAM ENGINE OF HIGH EFFICIENCY.

Referring to the diagram, in which dimensions are given in millimeters, the high and low pressure cylinders of an ordinary compound steam engine are represented, with a stroke of 500 millimeters (19·69 inches) and a speed of 41·5 revolutions per minute. From the low-pressure cylinder the exhaust steam passes into the surface condenser, called in the diagram the "vaporizer." In this vaporizer, or condenser, the cooling medium used, instead of water, is liquid sulphurous acid (H_2SO_3), which has a boiling point so low that it is immediately decomposed by the heat of the exhaust steam, whereby the sulphur dioxide gas (SO_2) is liberated, which passes over into the cylinder of the auxiliary engine where its work is done as in an ordinary steam engine. The auxiliary cylinder has a diameter of 300 millimeters (11·81 inches) and a stroke of 500 millimeters, with a speed of 77 revolutions per minute.

After passing through this cylinder, the sulphurous vapor enters the surface condenser, around the tubes of which cold water flows as in an ordinary steam plant. Here the sulphurous vapor is condensed to liquid and is forced by the pump back into the vaporizer, where it begins its cycle again, the same SO_2 being used over and over again indefinitely. There are, therefore, in fact two condensers, the first serving, as it were a boiler or steam generator for the auxiliary engine; and this boiler, instead of being fired by coal, obtains all its heat from the exhaust of an ordinary steam engine, and instead of converting water into steam, evaporates a liquid which is much more volatile—i. e., has a far lower boiling point.

In the long series of recorded tests with the plant shown in the engraving herewith transmitted, the following results were attained :

The steam engine is of the compound type, of good, modern construction, and, being given a steady load, developed 34 indicated horse power, with a consumption of 8·6 kilogrammes (18·96 pounds) of steam per

indicated horse power hour. The auxiliary machine working with the sulphurous vapor indicated 19 horse power—that is, an increase of 56 per cent and yielding, instead of 1 horse power, 1·56 horse power for the same steam consumption and reducing the steam consumption from 8·6 kilogrammes to 5·5 kilogrammes (from 18·96 to 12·13 pounds) per indicated horse power.

The experiments showed on the average that for every 15 kilogrammes (33·169 pounds) of steam passing through the main engine, 1 horse power could be gained in the auxiliary machine. Applied, therefore, to an ordinary single cylinder steam engine, exhausting into the air at high temperature, the percentage of power saved by this new device would be very much higher than the economy reached in these experiments, which, as has been shown, were made with a highly improved compound engine. From the average of these experiments, it may be broadily stated that given a fairly economical compound engine, using 7½ kilogrammes (16·5 pounds) of steam per indicated horse power hour, half an indicated horse power could be produced in the auxiliary machine for every indicated horse power developed in the main engine. Assuming an average vacuum of 60 centimeters (23·62 inches), corresponding to a temperature of 60° Celsius (140° F.), the saving of heat must be accomplished by using a liquid which can be vaporized to a high pressure at or below that temperature. Assuming, further the upper and lower limits of temperature within which the operation is confined to be 60° and 20° Clesius (140 and 67° F.), the pressure of the sulphurous vapor would range from 10·05 down to 2·35 atmospheres above open air pressure. A working pressure as high as ordinary steam boiler pressure is therefore readily obtained at a comparatively moderate temperature. Moreover, the volume of sulphurous acid vapor necessary to contain the number of heat units corresponding to the work to be performed is much smaller than the volume of steam which would be required for the same purpose. As the saving to be effected by the auxiliary engine depends directly upon the difference between the highest and lowest temperatures involved, the greatest gain will therefore be made either when the water in the surface condenser is as cold as possible or when the heat of the exhaust steam from the engine is at a maximum, as is the case with a single cylinder steam engine without condenser, which may be anywhere up to 212° F.

The expense of this improvement is practically all in the construction cost of the vaporizer, condenser, and auxiliary engine itself, and its economy may be realized from the fact that the exhaust steam from a 2,000 horse power central-station engine should furnish power to drive an additional 1,000 horse power engine, which can be connected as an extra cylinder to the steam engine or run independently, and thus increase by 50 per cent the power developed without adding a pound to the quantity of fuel consumed. When, in view of the present coal famine throughout Europe, it is remembered that the steam engine energy of Germany alone, afloat and ashore, is not less than 3,717,264 horse power, the commercial importance of such an improvement will be readily apparent.

The Telegraph at Victoria Nyanza.

The completion of the telegraph from the Indian Ocean to Victoria Nyanza puts the world in communication with the sources of the Nile. The telegraph line has been completed as far as Ripon Falls, which is the point where the White Nile leaves the lake. The people of Lower Egypt will not be able to tell what the water conditions of the Lower Nile will be for months in advance, so that they can regulate the quantity to be taken from the Nile for irrigation purposes. Information as to the state of the water in the Upper Nile would at times be worth millions of dollars to Lower Egypt. At present despatches from Victoria Nyanza will have to be sent by steamer to be put on the cable at Zanzibar. This will, of course, delay messages for several days, but five years ago, says The New York Sun, when the building of this line and the railroad alongside of it was commenced, the shortest time in which the news from the lake could reach Europe was about four months.

ELECTRICAL properties have been recently seriously damaged by storms. In Cleveland, Ohio, the street car lines were tied up for a day, and 8,000 telephones were put out of service and 4,000 miles of wire was down the day after the storm.

FILTRATION PLANT FOR THE ALBANY WATER SUPPLY.

The water supply of the city of Albany, which was originally obtained by gravity from certain reservoirs on small streams to the west and north of the city, was augmented in 1873 by taking water from the Hudson River through an intake in the river, opposite the heart of the city. In recent years the amount of water drawn from this source has greatly exceeded that obtained from the reservoirs above mentioned. At low water stages, owing to the tidal currents, considerable sewage is carried up-stream to the intake, and the sewage of the city was thus present in a very considerable amount in its own water supply. In addition to the local source of pollution the river received the sewage of Troy, Schenectady, Utica, Rome and many other towns further up the river. Under such conditions it is not surprising that the death rate in Albany was excessive.

As a result of the investigation by the Water Board made in 1896 by its superintendent, Mr. George I. Bailey, C.E., and by Mr. Allen Hazen, C.E., a report was presented in February, 1897, which recommended that the present intake be abandoned, a new one established at a point about two miles further up the river, clear of the local source of pollution, and a filtration plant established at that point. This important work has been carried through and forms the subject of the accompanying illustrations.

SOURCE OF SUPPLY.—The Hudson River at the point of the intake has a drainage area of 8,240 square miles, the average annual flow of the streams amounts to at least 1,000,000 gallons per square mile per day, or over 8,000,000,000 gallons per day, while the minimum flow is only a small fraction of this amount. The minimum flow of the Hudson at Albany is about 1,060,000,000 gallons per twenty-four hours. This is about a hundred times the average amount of water taken from the river for waterwork purposes. The Hudson River opposite the filtration works flows in two channels which are formed by a long, narrow island. The main channel of the river, which formerly flowed between the island and the city has now been diverted to the other channel as the result of the construction of a dike by the United States government to improve navigation. The investigation of the water showed that that in the back channel was considerably better than the water in the main channel, and the intake was accordingly located in the former. The intake consists of a simple concrete structure in the form of a box with an open top covered with rails placed 6 inches apart, and from the box a 36-inch pipe leads to a well in the pumping station. Before going to the pumps the water passes through a screen with bars 2 inches apart. The centrifugal pumps at the pumping station have a guaranteed capacity of 16,000,000 gallons per twenty-four hours against a lift of 18 feet or of 12,000,000 gallons per twenty-four hours against a lift of 24 feet. The pumping station building, to a point above the highest flood level, is of massive concrete construction without any openings. Upon leaving the pumping station the water passes through a 36-inch Venturi meter, which records the quantity of water pumped, and is also arranged to show on gages in the pumping station the rate of the pumping.

AERATION.—After leaving the meter the water passes to the sedimentation basin through eleven outlets, which consist of 12-inch pipes stood on end, the tops of which are 4 feet above the nominal flow line of the sedimentation basin. Each of these outlet pipes is pierced with 296 ⅜ inch holes, extending from 6 inches to 3 feet 6 inches below the top of the pipe. The area of these holes is so computed that when 11,000,000 gallons of water per day are pumped, all the water will pass through the holes, the water in the pipes rising until it is just flush with the tops. The water is thus thrown out in 3,256 small streams and becomes thoroughly aerated. When more than the above amount is pumped, the excess flows over the tops of the outlet pipes in thin sheets, which are broken up by the jets, Although no observations have been taken on the Hudson River, experience with the Merrimac at Lawrence, where the conditions are in many respects similar, shows that since the water is at all times more or less aerated, and during the greater part of the year is nearly saturated with oxygen, aeration is not necessary. During low water, in the summer season, however, there is much less oxygen in the water, and at these times aeration is a distinct advantage. Another advantage of aeration is that it tends to remove the slight odor which is liable to exist in river water.

SEDIMENTATION BASIN.—From the outlets the water falls into a large basin measuring 382½×600 feet, which is located with its longer side approximately parallel to the banks of the river. The basin has an area of 5 acres, and is 9 feet in depth. To the overflow line it has a capacity of 14,600,000 gallons, and to the flow line of the filters 8,900,000, the reserve capacity being, therefore, 5,700,000 gallons. The basin, which is close to the river bank, is built largely above the natural surface of the soil. The embankments are made of the clay obtained in excavating the filters, mixed with gravel from the river, these materials being put down in alternating layers and well rolled. The outside of the embankment is covered with soil, the inside and bottom with 16 inches of puddle, which is protected from frost on the sides by a covering of gravel, above which is a rough bluestone pavement.

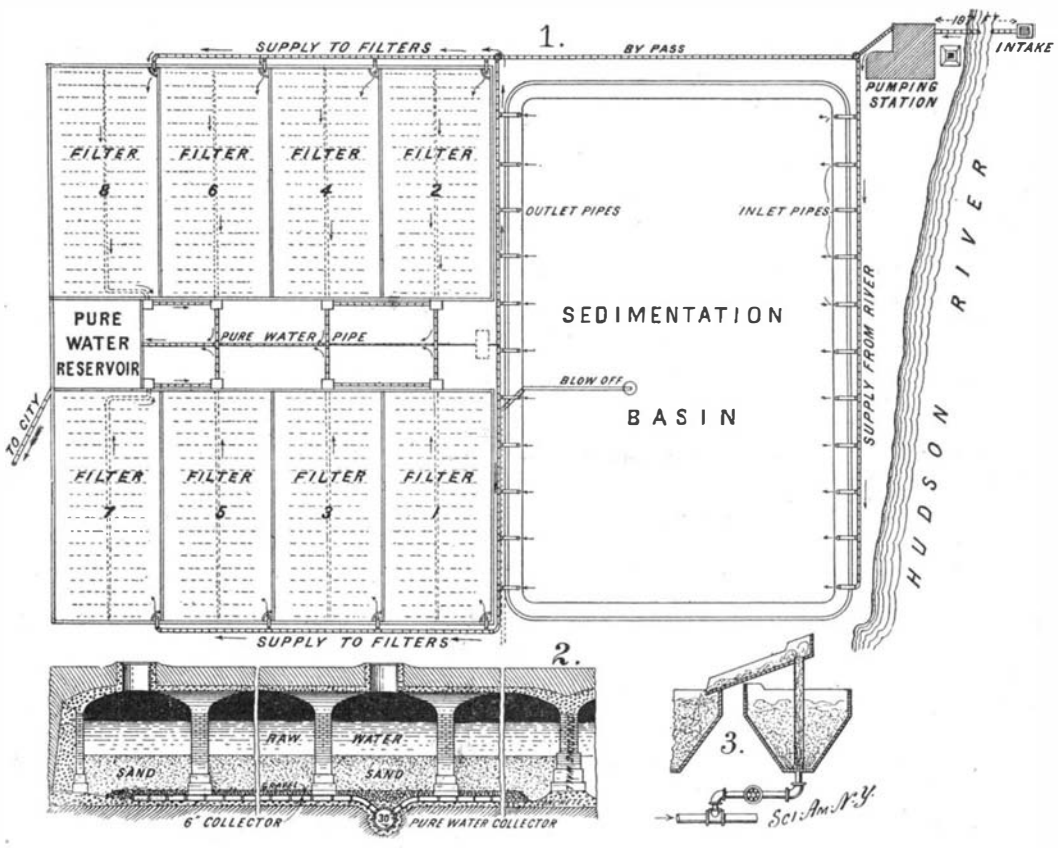
The water enters the sedimentation basin from eleven inlets along one side, and is drawn out from eleven inlets directly opposite. The floor of the basin is built with even slopes from the toe of each embankment to a sump, from which a 24-inch pipe leads to a large manhole in which there is a gate through which the water can be drawn, in emptying the basin.

THE FILTERS.—The filters, which are built of masonry, are covered to protect them from the severity of the winter weather. The piers, cross-walls and linings of the outer walls, entrances, etc., are of vitrified brick, while all other masonry is concrete. The average depth of the excavation for the filters was 4 feet. The floors consist of inverted, groined, concrete arches, arranged to distribute the weight of the walls and vaulting over the whole area of the bottom. The bottoms were put in alternate squares, running diagonally with the pier lines, as shown in the accompanying illustration. The vaulting was designed with a clear span of 12 feet, a rise of 2½ feet and thickness of 6 inches at the crown. Above the vaulting there are 2 feet of earth and soil, grassed on the top. The tops of the manholes are carried 6 inches above the soil to prevent the entrance of rain water. The manholes of the filters are provided with double covers of steel plates to exclude the cold.

THE UNDERDRAINS.—At the bottom of the floor of the filters between each line of piers, is a line of transverse 6-inch vitrified pipe collectors, laid with open joints, which connect with a main underdrain, laid beneath the floor of the filter and extending throughout its whole length, as shown in the accompanying plan. Tho main drains were put in before the construction of the filters was commenced. They are entirely surrounded with concrete. The main effluent collectors are 30-inch vitrified pipes reduced to 20-inches at the outlets.

FILTER GRAVEL.—The gravel surrounding the under drains is of three grades. A coarse grade of gravel of from 1 to 2 inches diameter is laid immediately over the 6-inch drains; the second grade which is laid immediately above it is from about ⅜ of an inch to 1 inch in diameter, while the finest gravel forms a third layer whose grains are from 3/16 to ⅜ of an inch in diameter.

The coarse gravel entirely surrounds the 6-inch pipe drains and is carried slightly above their tops. The second grade fills up all the spaces on the floor to within 2½ inches of the finished surface of gravel; the finest grade being applied in a layer which is about



THE ALBANY FILTRATION PLANT.
1.—General Plan. 2.—Section Through Filter. 3.—Detail of Sand Washing Machine.

2½ inches deep. Above the gravel is placed a layer of sand 4 feet deep. The specifications for this sand require that it shall be clean, river, beach or bank sand with either sharp or rounded grains, that it shall be free from clay, dust or organic impurities. The sand has effective sizes averaging 0·31 millimeter.

Most of the suspended matters in the filtered waters are held by the top layer of sand which is removed from time to time. The dirty sand is washed and eventually replaced in the filters. Two ejector sand-washing machines, of the type shown in the drawings, are provided at convenient places between the filters. In them the dirty sand is mixed with water and is thrown up by an ejector, after which it runs through a chute into a receptacle from which it is again lifted by another ejector. It passes altogether through five ejectors, a part of the dirty water being wasted each time. The sand is finally collected from the last ejector where it is allowed to deposit from the water.

The cost of this filtration plant was for the sedimentation basin $60,000, for the pure water reservoir in which the filtered water is collected before going to the city, $9,000, and for the filters $255,000. The complete filters, including the piping, cost $45,000 per acre of net filtering area, exclusive of the land and engineering.

RESULTS OF OPERATION.—The filters were designed to remove from the water the bacteria which causes disease. They have already reached a bacterial efficiency of over 99 per cent. The disease directly traceable to the sewer-polluted waters of the Hudson was typhoid fever, the death rate from which in the city of Albany, had been large, the average number of deaths from this cause for nine years, ending 1898, being 85 per annum. During the first four months in which the filters were in operation seven deaths from this cause have been reported. For the corresponding time for the nine years ending 1898, the average number of deaths was 24, so that the filtration of the water has reduced the deaths from this cause in the ratio of 24 to 7. The St. Lawrence filtration plant has reduced the typhoid fever death rate from 11·31 to 2·54. The filtration plant of the city of Hamburg, Germany, was put in operation in 1895 and for the five years previous to that date the average typhoid fever death rate was 4·72, and subsequently to that date it has fallen to 0·72. The filtration plant of the city of Mount Vernon, N. Y., was opened in 1894, since which date the number of deaths from typhoid decreased over 76 per cent. The cost of operation of the whole plant, as shown by figures furnished by Mr. George J. Bailey, the superintendent of the works, was $6,165 for the period September 5 to December 25, of last year. This included the payroll, tools, repairs, supplies, etc. In this period 1,470,000,000 gallons were filtered, the average cost per million gallons being therefore $4.19. The average cost per million gallons of the operation of the pumping stations was $2.52, leaving $1.67 to represent the cost of operating the filters, including the laboratory work.

We are indebted for our illustrations and particulars to the courtesy of Mr. Allen Hazen, Assoc. M. of Am. Soc. C. E., who was responsible for the design and construction of the plant.

Death of Piazzi Smyth.

Charles Piazzi Smyth, Ex-Astronomer Royal of Scotland died on February 21. He was born at Naples, and was called "Piazzi" after the discoverer of Ceres who was the official astronomer of the two Sicilies. He was interested in science at a very early age, and in 1845 was appointed Astronomer Royal of Scotland. He tried for many years to get a new observatory and at last he resigned after protesting vigorously against the ways of officialdom. He then retired to Clova in Yorkshire where he devoted himself to the photographic study of the solar spectrum and of cloud forms. He is best known, however, by his eccentric views relative to the Great Pyramid. A controversy relating to this "paradox of a very high order" as De Morgan called it, led to his resignation, in 1874, of his Fellowship of the Royal Society. Among his views were that the Great Pyramid was erected under the eye of Melchisedec, according to a divinely inspired plan. Its interpretation, moreover, heralded the beginning of the millenium in 1882. The Israelitish origin of the Anglo-Saxon race and the reprobation of the decimal system of weight and measures were among his ideas.

A Music Library in Geneva.

A unique enterprise of certain music dealers in Geneva may be of interest to our readers. Dealers keep very large stocks of all kinds of classical and popular music, to all of which access may be had for a subscription fee of 50 cents a month, depending upon the number of pieces taken. Thus, three pieces may be taken for 50 cents a month or $2.40 a year, and twelve pieces of music at a time for $1.10 a month or $5 per year. This is a great boon to students who cannot afford to buy at will, and the dealers are being well repaid for their enterprise.

A NEWSPAPER is printed at Jacksonville, Fla. with the aid of acetylene gas as engine fuel

Science Notes.

The Ministry of Public Instruction in France encourages art by an annual expenditure of $3,600,000. This includes the support of the Ecole des Beaux-Arts and ten other state schools of fine arts.

The Italian government has brought forward a bill authorizing the purchase of all the pictures in the Borghese collection. The government valuation of $700,000 is a very low one and is not at all commensurate with the treasures it contains.

The excavations which M. Gauckler is conducting at Carthage, for the French government continues to produce remarkable finds. If the excavations keep on being as productive as they have been in the past, we may expect to see illustrations of "Salammbo" which will be archæologically correct.

An epidemic of typhoid fever has recently been traced to the use of celery grown on some sewage fertilized ground. As it occurred in an institution it was very easy to trace the cause. Owing to the peculiar nature of the stems it is very easy for them to become saturated with fertilizing material.

Women physicians have established themselves all over Russia and they have achieved a respected position. Some of them are employed by the government, and since last year are entitled to a pension. Many of them occupy positions as country physicians, school physicians, physicians for the poor and as surgeons for the municipal ambulance system, etc.

Wherever land is valuable for agricultural purposes the fact that wire fences take up little space is becoming more and more recognized. Stone fences are often 3 to 6 feet wide, and therefore, waste many acres of valuable soil on every farm. The zigzag fence waste a considerable amount of land. The hedge is also wasteful and they may profitably all be torn down and replaced by wire fences, for the crops which could be obtained from the area thus reclaimed would soon pay for the fence.

One of the Eastern novelties is a playhouse for children. It is 9 feet 6 inches in length, 6 feet 4 inches in width and 8 feet 9 inches in height. They are made of white pine and are painted with one coat of paint outside. They are provided with a door and windows which can be changed at will. The house can be built in an hour and taken down in twenty minutes, no nailing or carpentry being required. They are wind and waterproof and would undoubtedly furnish an excellent out-of-door study for an adult.

Sanitarians have virtually decided that street noises have an effect upon the health, and certainly the crying of "extra" newspapers has a bad effect upon many nervous people. We are pleased to note that an Englishman prosecuted a newspaper yeller for obtaining money under false pretences, as the words in which the blatant vender described his wares was not in accord with the news in the paper. In most cities it is against the law to call newspapers on Sundays and anything which will tend to make life peaceful will be warmly welcomed.

From a series of experiments carried on by Herr Müller-Thurgau on the effect on the growth of plants of an extra supply of nitrogen to the roots, he derives the following general conclusions: The roots are enabled to form an abnormally large amount of albuminoids when the nitrogen is presented to them in the form of a nitrate, but only if they can obtain a sufficient supply of sugar. This is manifested in the greater length and thickness of the roots, in their greater branching, and in the increased amount of protoplasm in their cells.—Bot. Centralblatt.

The hygienic exhibit for the Paris Exposition has been shipped, nearly every State contributing its quota. As we have no national department of public health the work was entrusted to Dr. Samuel W. Abbott, secretary of the Massachusetts State Board of Health, as special agent. The space was so very limited that with few exceptions books only could be shown. The exhibit includes maps, charts of vital statistics, albums containing photographs of municipal health work, plans of hospitals, circulars of State and local boards of health, etc. Samples of the product of private and public producers of antitoxins and vaccine lymph will be shown.

In France meat unfit for food and bodies of animals that died of disease are exclusively used for the manufacture of super-phosphates, says The Sanitarium. The meat is placed in a vat containing sulphuric acid which separates the resulting nitrogenous product from the fat. The dead animals are thrown whole into the covered lead-lined vats full of sulphuric acid. If they have died of anthrax or glanders they are cut up before being thrown in. In forty-eight hours the fat alone remains, and the animalized sulphuric acid, which is now so rich in nitrogenous substance is drawn off and sent through an undergound conduit to the superphosphate factory. Instead of the unsanitary method of burying such putrid substances directly in the ground they are effectually disposed of by the complete destruction of the injurious germs, and the product is available for the manufacture of valuable fertilizer.

Electrical Notes.

Electric traction will be used on the Berlin Elevated railroads.

An electric trolley will be laid betweem Milan and Varese, Italy.

The Metropolitan and District Railway Companies, of London, are about to work experimentally a line between Earl's Court and High Street by electricity. A third-rail is to be used, current being supplied at 500 volts.

A resident of Philadelphia has recently obtained a verdict of $15,000, through the instrumentality of the X-rays. The plaintiff was injured on a street railway car. Dr. M. K. Kassabian was the X-ray expert in the case.

The work of the signal corps of the army in the Philippine Islands has been excellent. The corps has handled an average of 2,500 dispatches each day since the American army landed at Manila, and the maximum was 4,000 on November 6.

Electric flatirons are used exclusively in many large laundries; their advantages are apparent. The heat can always be controlled so as to keep the iron at the right temperature thus obviating the danger of spoiling a finished dress by smut from an iron heated by gas.

The British War Office has been testing for the last two years a new electrical range finder. It was invented by an Australian. It will give the range and bearing of a fixed or moving object and will give information to any number of fortress guns attached by wire to the instrument.

The plans for the new Philadelphia Mint call for a large equipment of electrical machinery including fourteen 45-horse power motors for the coining department, sixteen 5-horse power cutting motors, six 25-horse power finishing motors; and one 5-horse power hydraulic motor. An electro-refining equipment is desired for the melting and refining departments.

The street car system at Frankfort is now electrical for the most part, and operations are being made for changing most of the other lines. Great precautions are taken to prevent accidents and should an overhead wire break an ingenious device renders it harmless. When necessary repairs have to be made, or when the Fire Department is at work, it is arranged so that the operation of the line can be interrupted for a certain distance.

It has been found that alternating currents of high frequency and low potential may be used to sterilize liquids. The objection to electricity for this purpose has always been that a current powerful enough to do any good would decompose the liquid, thus rendered useless. An apparatus has been devised for the treatment of wine which consists of a small tube through which the wine passes. Inside the tube there is a series of metal disks which are insulated and connected with the current. The speed with which the liquid passes through the tube can be regulated easily, and the current kills the microbes and tends to preserve the wine.

At a recent meeting of the American Society of Mechanical Engineers, the question of how small a tool it pays to operate with an individual electric motor, was discussed. Prof. Jackson stated that all large tools or machines, requiring from 5 to 7½ horse power and over, should be provided with individual motors, while smaller tools or machines requiring less power should be grouped and driven from a motor-driven shaft. These groups should ordinarily be arranged so that a motor from not less than 3 to 5 horse power is required and not more than from 10 to 15 horse power. Each industry includes conditions of its own which should also be taken count of. At the Baldwin Locomotive Works motors under 5 horse power are not used for any purpose.

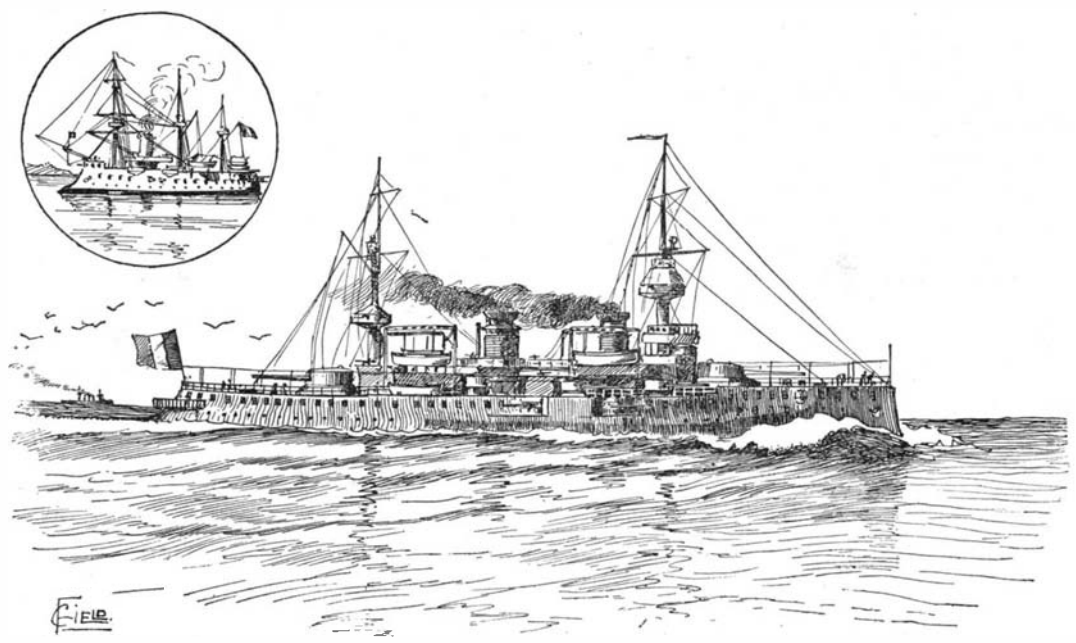
Wiedemann has shown that the the temperature of a gas showing the ordinary vacuum phenomena is in general below 100°. He concluded that the luminosity is not a phenomenon of incandescence, but of phosphorescence. This conclusion has since been corroborated, but the experiments are complicated by the fact that the introduction of a hot body in itself reduces the discharge potential and increases the current through the tube. J. Stark introduces white-hot carbon filaments into the tube at various points, and keeps the current constant. If the filament is in the region of positive light, it reduces or extinguishes the light. If it is stratified, the filament cuts pieces out of the bright strata. A short positive column is totally extinguished by the filament. The negative light is enfeebled, but the luminescence of the walls is unaffected, thus showing that the cathode rays are not influenced by the presence of the hot body. The heating simply deprives the gas of its power of phosphorescence under electric charge. We know that a rarefied gas is ionized by heating, and must therefore conclude that an ionized gas does not phosphoresce under the influence of the electric discharge. This, again, indicates that the phosphorescence is a molecular rather than an atomic phenomenon.—J. Stark, Ann. der Physik.

THE NEW FRENCH BATTLESHIP "SUFFREN" AND HER PREDECESSOR.

"The Bailiff de Suffren was one of the most dangerous enemies that the English fleets have ever met, and, without exception, the most illustrious officer that has ever held command in the French navy." So writes Prof. Laughton in his interesting "Studies in Naval History," and it is an eulogy which the famous French admiral who gave our naval commanders so much trouble in East Indian waters well merits. This being the case, it is but natural that our cross-channel neighbors should keep his name alive in that of one of their battleships. A fine new armorclad bearing this distinguished name was launched at Brest on July 25 last, and is a successor to an older ironclad of the same name now no longer effective. The latter was one of those wooden-hulled armor-plated ships that for some years handicapped the advance of the French navy, and dates from 1870, the year of the great "debâcle." She was of 7,600 tons displacement, plated with 6 to 8 inches of iron and had a speed of about 14 knots. Her new namesake is a far more formidable vessel.

To begin with she is nearly twice as big, as she will, when complete, displace 12,728 tons of water, and the French are congratulating themselves on the record she has made in rapidity of construction, as at the time of her launch she had only been 200 days in hand from the date of laying her first keel-plate. She was built from the designs of M. Thibaudier, and as she took the water received a blessing from Monsgr. Oury, the Archbishop of Algiers, in honor of whom, at the banquet which followed, Admiral Barrera proposed the following toast: "Let us drink to the French episcopate, to the army and to the navy, the three forces on whose absolute devotion France can reckon."

As will be seen from the sketch the "Suffren" will, when complete, be an imposing fighting unit, and her armor and armament will render her an ugly antagonist. Her main battery consists of four 12-inch guns placed in pairs in heavily armored turrets, placed fore and aft on the center line of the ship, while her secondary armament comprises ten 6·4-inch quick-firing cannon. Four of these are in a central casemate, with recessed ports, so that they can be fired either on the broadside or ahead and astern. The remaining six are placed each in a single armored turret, three on either beam. The central one in each case is much further out from the central line of the ship than the others, so that four of these guns can be fired ahead and the same number astern. Besides these the "Suffren" carries, or rather will carry when completely equipped, eight 3·9-inch rapid-firers, a score of lighter weapons, and four torpedo tubes. Of these two are placed in a submerged position below the water line. In order to protect her vitals from an enemy's fire she is fitted with a complete belt of Harveyized steel armor 11 inches in thickness and a steel deck nearly 2 inches thick, which curves upward from the lower edges of the belt. Above the belt proper the "Suffren" is protected by another band of 3-inch armor which extends from the bow to the aftermost turret, and above this again is the central battery covered with 5½-inch armor. The smaller turrets have an equally thick protection while the larger ones are plated with armor 11 inches in thickness, while the barbette is just about an inch thinner. The "Suffren" will have three propellers, Niclausse boilers, and is estimated to steam 18 knots at full speed. C. Field.



FIRST-CLASS FRENCH BATTLESHIP "SUFFREN."

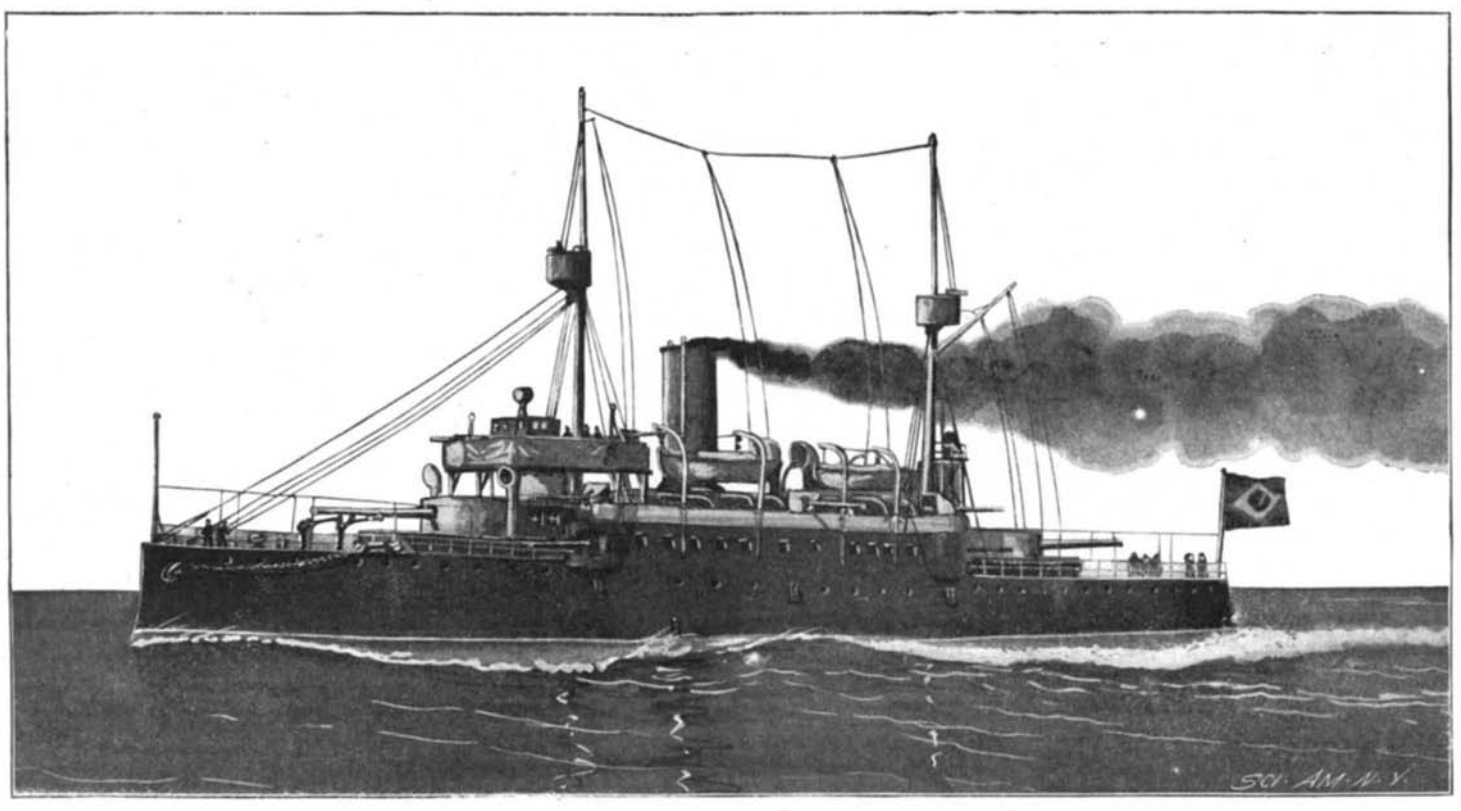
Displacement, 12,728 tons. **Speed,** 18 knots. **Maximum Coal Supply,** 1,100 tons. **Armor:** Belt, 11 inches; upper belt, 3 inches; deck, 2 inches; main turrets, 11 inches; secondary turrets, 5½ inches; central battery, 5½ inches. **Armament:** Four 12-inch B. L. R., ten 6·4-inch R. F., eight 3·9-inch R. F., twenty 1·8-inch R. F. **Torpedo Tubes,** four (two submerged). **Complement,** 650. **Date,** 1900.

THE NEW BRAZILIAN ARMORCLAD "MARSHAL DEODORO."

Within the last few weeks the Brazilian navy has received a new recruit in the little ironclad "Marshal Deodoro," which has been built at the celebrated "La Seyne" yard at Toulon. Some little interest attaches to this vessel, as it is thought that she, when anchored at Las Palmas on the way out, was suspected by the British cruisers of being a privateer fitted out in the interest of the Boer government to attack their transports on their way to South Africa. Whether she was not at that time properly in commission or had not been handed over formally to the Brazilian government, and so did not fly the ordinary colors of a warship belonging to Brazil has not been stated, but the precaution of steaming for one or two nights when in that latitude with all lights masked, was carried out by one or two of the troopers at the suggestion of the officers commanding the British cruiser which at that time lay off Las Palmas. The newness of the "Marshal Deodoro" may have had something to do with the matter. She had only then quitted Toulon for the first time and so was probably not recognized.

The "Marshal Deodoro" is one of the small class of battleships which now-a-days are built only for second-rate naval powers, a large displacement being the rule in all important navies. Still for her size she is a formidable little vessel, and the only wonder is how, on a displacement of only 3,200 tons, so much armor and armament can be carried. She is provided with a complete belt at the water line of more than 11 inches in thickness, an armored deck about 2 inches thick, 8-inch plating on her two turrets, while her casemates have about 3 inches of protective armor. There is also an armored conning-tower nearly 4 inches in thickness for the use of the captain when in action. Her armament consists of two long 9·4-inch cannon, one in either turret; four 4·7-inch quick-firers in the casemates at the corners of the superstructure; and a couple of 5·9-inch mortars or howitzers. The latter are not usually to be found on board a war vessel of the present day, though in the early part of the century mortars were sometimes carried by French line of battleships. In addition to the weapons already enumerated, the "Marshal Deodoro" carries about a dozen small rapid-fire guns and a couple of torpedo tubes. These are placed below the water line, the only safe place for them, if we are to be taught by the occurrences of the battles of the Yalu and of Santiago.

All men-of-war designs are in the nature of a compromise between armor, armament, speed, and coal capacity, and the "Marshal Deodoro" having so much displacement devoted to the two former, naturally suffers in the latter. Her speed is not more than 16 knots, a very slow rate of progression for a modern battleship. Her bunker space, too, in all probability, is limited. She is provided with two screws, and is equipped with two light masts, each of which carries a single open military top. Though, of course, unable to contend with a battleship of the ordinary size, yet the "Marshal Deodoro" would prove a formidable opponent to any armorclad of an approximating displacement and also to a cruiser much more numerously gunned. C. Field.



BRAZILIAN BATTLESHIP "MARSHAL DEODORO."

Displacement, 3,200 tons. **Speed,** 16 knots. **Normal Coal Supply,** 236 tons. **Armor:** Belt, 11 inches; deck, 2 inches; turrets, 8 inches; casemates, 3 inches. **Armament:** Two long 9·4-inch B. L. R.; four 4·7-inch R. F.; two 5·9-inch howitzers; four 6-pounders; two 1-pounders. **Torpedo Tubes,** two (submerged). **Complement,** 200. **Date,** 1899.

The Jesup North Pacific Expedition.

Dr. Berthold Lanfer, of the American Museum of Natural History, has just returned from two years of exploration in Northern Asia, as the representative of the Jesup North Pacific Expedition. He has lived during this time in Manchuria in the Island of Saghlin. He brings back with him a choice collection of clothing, utensils, works of art, etc., which gave an idea of the manners, customs and culture of these strange peoples. The general plan of the Jesup expedition is to investigate first all the isolated tribes of Eastern Asia except those belonging to the Ural-Altaic stock. Russian influences are rapidly doing away with primitive languages and culture and with them all traces of man's early history in Asia which would be a severe loss to science. The tribes in question include the Tschuktschis on the extreme tip of Asia which are divided into two tribes, and reindeer people and fisher folk. Down to the left of these but northeast of Kamtschatka are the Koryaks, while on the northern coast of Asia along the Siberian (Arctic) Sea are the tribe of Yukaghees.

THE government of the Congo Free State has decided to adopt wireless telegraphy for the transmission of official dispatches in the Upper Congo region.

Comparative Noise On Different Pavements.

It is a favorite statement of those who are opposed to the use of asphalt for pavements, that the noise of the horses' hoofs upon them is intolerable. This statement having been made quite frequently of late, a gentleman in Philadelphia recently undertook to ascertain the facts in the case.

The method employed was to observe the noise from the hoofs as a horse passed from the asphalt to the granite, or the reverse. This was easily done at points where the asphalt ended and the granite began, especially if a car track passed along the street. It was also, at such points, easy to note the sound made by saddle horses as they went from one pavement to the other. In the case of horses attached to wagons, those only could be observed when the wheels were in the car tracks, and the noise from them was thus practically obliterated.

Observations carried on at intervals covering some three or four weeks developed the fact that the noise made by the hoofs of horses is practically the same on granite and asphalt. It is, if anything, a little sharper on the granite, the asphalt seeming to have a slightly subduing effect on the impact of the shoe.

It is found that on both granite and cobble stone pavements the noise of the wagon entirely drowns the noise of the horses' feet, a quick ear being required to detect the sound of the shoes. The sound of the wagon is, as nearly as one can guess, ninety per cent of all the noise coming from rough pavements. The state of the case then is about this: When we have taken away ninety per cent of the noise, what remains causes greater complaint than the whole. For the noise of the wheels and rattle of the wagon is actually extinguished on the asphalt, leaving only that of the hoofs.

It would appear self-evident to persons who were disinterested that this was the case. Yet arguments against asphalt are so difficult to obtain, that anything is seized upon for the purpose and urged to the utmost. One opponent of asphalt gravely wrote a few weeks since that cyclists were suffering from a dryness of the throat, caused entirely by riding over asphalt.

The arguments against asphalt on account of the noise which horses make upon it and the smoothness of it in wet weather, are arguments against the horse rather than against the pavement. It is quite within the mechanical possibilities of the age for us to give up using horses in our large cities and substitute traction engines and horseless vehicles for them. The smooth asphalt gives the mechanical carriage every advantage, and if our horsemen carry these arguments too far, they may find that they have proved too much, and people will say: If our pavements are not good enough for your horse, your horse must go. Strange things have happened within the last decade, and may be expected again.

An International Exhibition at Canea.

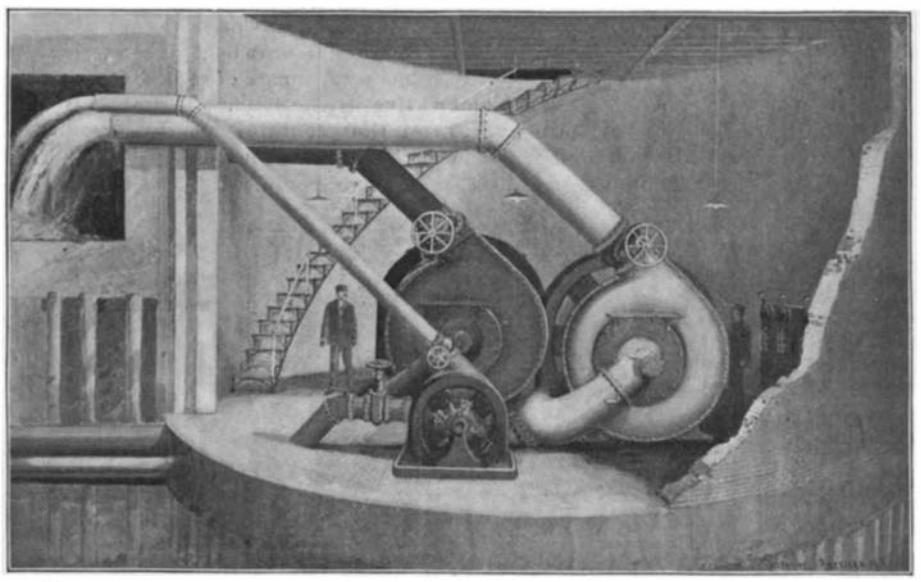
An International Exhibition under the auspices of Prince George, of Greece, will be held at Canea, on the Island of Crete, during the present year. The inhabitants of the island are exerting themselves to make the Exposition a complete success. Foreign consuls have recommended to their governments that everything be done to further this exhibition. Crete now affords an excellent market for many lines of goods. There will be an excellent passenger service to and from the island. The Exposition will be opened on April 11, and will be closed on May 7.

IT is a curious fact that workers in vanilla factories are affected with headache, lassitude, muscular pains, skin diseases, etc. Some of the workers had to give up their employment.

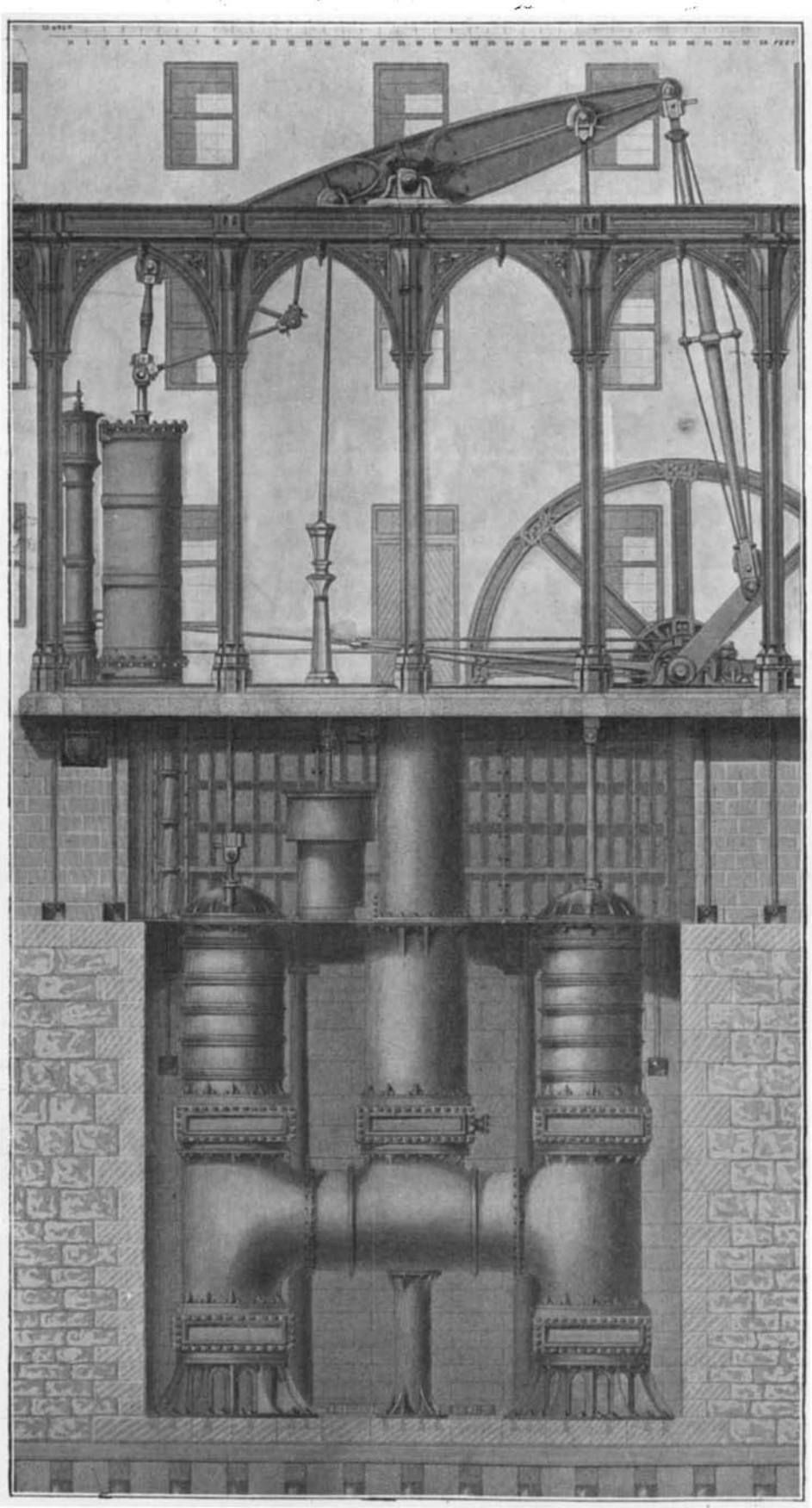
THE OLD AND NEW PUMPING ENGINES OF DRY DOCK No. 1, BROOKLYN NAVY YARD.

The reconstruction of the pumping plant of Dry Dock No. 1, which will shortly take place at the Brooklyn Navy Yard, will afford a striking evidence of the advance which has been made during the past half century in the construction and economy of operation of pumping machinery.

Our larger engraving is a side elevation of the original condensing, double-acting, beam engine and pumps, which were erected in 1851; while the smaller engraving, which is drawn to the same scale, represents the new electric pumping plant which it is proposed to erect in its place. The drawings being made to the same scale, the contrast between the elaborate and cumbersome design of the old, walking-beam engine, and the compact arrangement of the electrically-driven centrifugal pumps, is evident at a glance, particularly when it is stated that the pumping capacity of the smaller is nearly three times as great as that of the larger plant.



*Proposed Electric Pumping Plant—Capacity, 60,000 Gallons per Minute.



Old Pumping Plant of Dry Dock No. 1, Brooklyn Navy Yard, Installed 1851—Capacity, 22,000 Gallons per Minute.

* The two Drawings are reproduced on the same scale.

HALF A CENTURY'S DEVELOPMENT IN PUMPING MACHINERY.

At the same time we must be careful, in our modern self-sufficieney, lest we claim more credit than is warranted by the enormous advantage accruing from over half a century's experience in the construction and handling of pumping machinery; and it is questionable in view of our end-of-the-century advantages, whether the magnificent old engine which may still be seen in its spacious engine house at the Navy Yard, is not even more creditable to its designers than its up-to-date successor. In the description of the plant written by Mr. Charles B. Stuart, Engineer-in-Chief of the United States Navy, it is stated that at the time the plans were matured and adopted it was deemed important by the engineer in charge, Mr. McAlpine "that the machinery for exhausting the water from the dock should be of the most perfect kind and of great power and capacity also." This gentleman put in plans and specifications which after discussion by a special board, were adopted with some modifications.

The engine stands in a lofty room which is about 54 feet square. The frame consists of an entablature of cast iron, supported on double lines of Gothic columns and arches, which extend from end to end of the engine room. To modern eyes, the effect of the Gothic columns and arches, is exceedingly ecclesiastical and strongly suggestive of the nave of a cathedral. Howbeit these Gothic ormentations, incongruous as they look to-day, were fashionable half a century ago, and they were characteristic of the stately steamboat engines, after the pattern of which we are told the engine is largely modeled. Our illustration is reproduced from a beautiful steel engraving in a volume by Chief Engineer Stuart, on the "Naval Dry Docks of the United States." The author draws attention to the fact that it "shows very beautifully the style of ornamentation that has been given to the whole work, care having been taken to have all the parts in keeping with each other."

Coming now to details, the cylinder is 50 inches in diameter by 12 feet stroke; the walking beam is of cast iron and measures 31 feet between the end centers and weighs over 15 tons. The piston rod is attached to the beam by the old parallel motion, first designed by the celebrated Watts. The main pump and the air pump rods are connected to the walking beam by double rods and links, while the air pump cross-head works in slides attached to the columns of the engine frame. The engine has a trussed connecting rod the tension rods of which are adjustable by screws and nuts. The cast iron balance wheel is 24 feet in diameter and the crank and shaft are of wrought iron. The engine is provided with an independent adjustable extension gear, which is so arranged that as the load upon the engine is increased by the lowering of the water in the dock, an increased amount of steam is admitted to the cylinder. This is effected by means of a cam wheel on the main shaft, against which a cam roller, connected with the expansion valve stems is made to revolve, and along which it can be made to travel at any speed desired. A curious feature of the construction

of the engine was the use of eight 1½-inch iron rods extending from the engine frame to the rear of the large granite chimney "to secure as far as possible the frame from longitudinal motion or vibration, to steady the engine, and relieve the walls of the building."

The latter object was assisted by placing two inches of India rubber between the masonry and the iron entablature and pilasters, and also by placing India rubber washers between the bolt-heads and the exterior parts of the walls. No feed pumps were attached to the engines, the boilers being fed from the rainwater system beneath them by direct acting steam pumps built by Worthington & Baker. The steam was supplied by three boilers 26 feet in length, 7 feet in diameter in the waist, of the single return drop flue type.

In the well, below the foundation plate of the engines were two lifting pumps, each 36 inches in diameter with an 8-foot stroke. In addition to the usual suction valve near the bottom of the pump chamber, there are two suction valves placed near the bottom of the suction pipes. The valve seats are of a composition metal. The suction pipes connect with an air chamber, placed centrally between the pumps, which reaches to the bottom of the engine bedplate. The total weight of the metal in the engine is 267 tons and the total cost of the engine was $90,241.29.

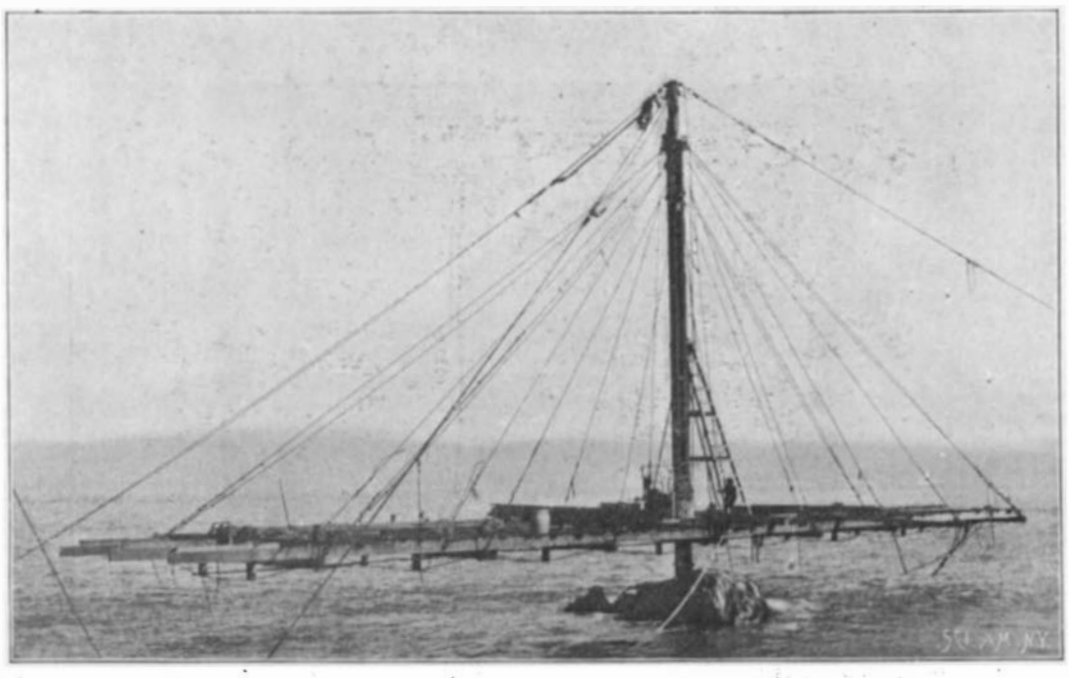
The new pumping plant, as planned by Capt. P. C. Asserson, Civil Engineer, of the Brooklyn Navy Yard, will be placed in a circular sunken chamber below the surface of the ground. It will consist of two 30-inch direct-connected, electrically driven centrifugal pumps, with a combined capacity of 60,000 gallons per minute. There will also be a 12-inch electrically driven centrifugal drainage pump as shown in the drawing. The ceiling of the subterranean engine room will consist of I-beams covered with 6 inches of concrete and one inch of cosmocrete. The cosmocrete finish will be at the general grade of the Navy Yard, and entrance will be had to the pumps by means of a hatch opening onto a spiral stairway.

REMOVING OBSTRUCTIONS IN SAN FRANCISCO BAY.

Removal of some of the most important of the obstructions to navigation which exist in the harbor of San Francisco has been undertaken by the government and is now under way. The present movement contemplates obliteration of Arch and Shag Rocks and two of the neighboring shoals comprising altogether some fifty thousand square yards of soft conglomerate rock. The obstructions referred to lie to the northwest of Alcatraz Island, dividing the channel between it and Angel Island in two and forming dangerous currents in a portion of the bay right in the path of the most largely frequented route of passenger and freight traffic. The work will not be completed under two years, but when finished, will remove obstructions which have caused numerous wrecks and the loss of many lives.

Work has begun on Shag Rock, which at high tide lifts its dangerous summit only a few feet above the water. The shoal surrounding it is oblong in shape and, generally speaking, about 180 feet in diameter. The purpose is to level the rock so as to secure a mean depth of 30 feet at low water.

A mast composed of 12×12 scantling, 24 inches square and 68 feet high, has been raised on the top of the rock and secured by guys anchored to the floor of the bay. Suspended from the mast is a platform 30 feet wide and 180 feet in length which is arranged to turn in all directions. On this the steam drills are operated, driven from an engine occupying a barge alongside. The drill is driven somewhat below the depth contemplated and into the holes are placed sticks of dynamite which are exploded, a few at a time, and thus the rock is destroyed in small sections, the débris being dredged up from the bottom and deposited in the deeper portions of the bay. The platform is above the reach of the highest tide, and work can go on without interruption during even moderate storms. The amount of rock to be removed at this point is 3,799 yards. The work is under charge of Major W. H. Henry, Chief of the River and Harbor Improvements of the United States Corps of Engineers.

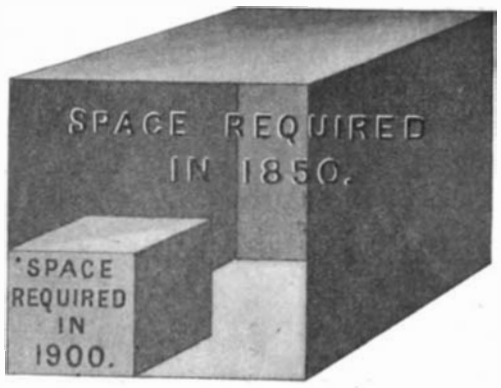


REMOVAL OF SHAG ROCK, SAN FRANCISCO HARBOR.

A LINE of automobile tourists' coaches is to be run in the Irish Lake district. The route is 55 miles long, and with the present horse traction the journey has to be spread over two days. The roads are very good, but there are two mountain passes which will try the hill-climbing qualities of the motors. If they prove successful all the horse coaches will be abandoned.

Clothing the Arid Regions with Vegetation.

The great arid and semi-arid regions west of the Mississippi are unable to sustain large flocks or herds because of conditions which prevent vegetation from producing reliable food crops. In the great Death Valley Desert the average rainfall is so small that most of our cultivated plants are withered up, and throughout large parts of the semi-arid regions this same lack of sufficient rain makes the life of farm crops at least very precarious and uncertain. Another drawback is that the alkali soil contains so much carbonate of soda that few plants can live and thrive in the land. Our common barley will live in soil that contains 25,000 pounds of alkali salts to the acre; but on a good deal of the land there are 30,000 and more pounds to the



COMPARISON SHOWING RELATIVE AMOUNT OF SPACE REQUIRED BY PUMPING PLANT OF THE SAME CAPACITY IN 1850 AND 1900.

acre, at which point barley withers up and dies. Even alfalfa, which generally does well in alkaline soils, will not flourish in some of the vast areas in the Rocky Mountain and Pacific Coast regions where the soil is intensely alkaline.

The agricultural experiment stations of the West have been experimenting for years with different plants which will thrive in these arid regions sufficiently to furnish food to cattle. The plants suited to such places have to live in a climate where there is very little rainfall, and in a poor soil, with a large percentage of alkali salts mixed with it. After years of tests with hundreds of grasses and plants the Australian salt bushes have given the best results and seem to promise wonderful changes in clothing the deserts with vegetation.

These Australian plants or salt bushes belong to the same class or family as the common pig weed of our gardens and roadsides, which is now looked upon by farmers as a great nuisance, although it was first introduced into this country as a great boon to the farmers. There are several members of this family which possess remarkable resisting powers to alkali in the soil and also to droughts. Experiments have been made with a great number, and the species that has given the most satisfaction is Atriplex semibaccata; but the California Experiment Station has also distributed for general use another trailing species. A. leptocarpa, and two shrubby species. Atriplex halimoides and A. vescicaria. These four species of Australian salt bushes have been found to possess the qualities which are needed for the dry, arid, alkali regions of the West.

In Australia these salt bushes are found in the regions of dry, hot summers with the annual rainfalls limited almost entirely to the winters. The difficulty of making plants thrive in such lands is well known to botanists, and the few vegetable growths that do flourish are usually devoid of any nourishing qualities as food for animals or human beings. The salt bushes are exceptions. They have fattening qualities for animals that is remarkable, and experiments have shown that they are equal pound for pound to alfalfas the great feeding plant of the West.

The Australian salt bushes are capable of flourishing on poor soils where most other plants do not succeed, and they will live in soils that contain as high as 50,000 to 70,000 pounds of alkali salts to the acre. Instances are on record where they have grown in soil impregnated at the rate of 75,000 pounds of alkali to the acre. On the "black-alkali" soil of the upper San Joaquin Valley, in California, the Atriplex semibaccata was tested successfully, although no other useful plant could ever be made to flourish there. In fact many of the species of salt bush failed to give a good crop on this land until the above species was tested.

Experiments have been made with the Australian salt bushes since 1881 in this country for the purpose of adapting them to the great arid plains. The well-known economic botanist, Baron Von Mueller, first sent the seeds of the Australian salt bushes to California in that year, and they were planted at the Berkeley station and several sub-stations throughout the State. For some time little progress was obtained, and the plants were not accorded the popularity their merits deserved. This was largely because the right species had not been discovered. The Atriplex semibaccata is a smaller plant than many of the others, and is a trailing rather than an upright growing species; but it has many advantages over all the others. When once established in any soil it covers the surface with vegetation, which remains green until heavy frosts, making a steady growth all the time. It is a perennial, and the roots are not killed by the frost, but sprout up again the following spring. It grows in strong alkali soil where other plants will not live, and in soils so poor that most vegetation dies for the lack of nourishment, and even in lands where there is a stiff hardpan and very little summer rain, All these points tend to make the plant the most valuable to farmers and cattle raisers in the Far West that has been discovered in the past quarter of a century. It will bring into profitable grazing use thousands of acres of arid land that has heretofore been worthless.

The salt bush will supply excellent and abundant food for hogs, sheep, cattle, and horses. Throughout the long dry summer season, it grows steadily and keeps green and succulent, from two to four crops in one season can be harvested from it. No matter how slight the rainfall may be the plant seems to thrive and produce its abundant crops. Where the alkali and poverty of the soil are very decided, the plant does not give its highest results, but even in its modified growth the crops it produces are sufficient to support a large number of cattle. From two to four cuttings of good hay make the average yield to-day in the arid regions where the salt bush has been established, and farmers in the arid regions are planting the crop as fast as they can secure sufficient seed.

The Tulare Experiment Station has distributed in the last few years about 5,000 pounds of seed. In a few years the wide distribution of the plants should enable the farmers to produce all the seed they will need, and the plants will then become established over a wider range of territory. The fattening and health-giving qualities of the salt bush especially recommend it to the growers of cattle and sheep in the great Western deserts and plains. The sheep not only like the vegetation as a food, but it is said that the animals brought up on it produce a wool of superior quality, with a fiber unusually strong, glossy, and even. It is claimed by some that the fine quality of the best Australian wool is due to the salt bush as a daily food. In this respect, however, some species of the plants are far better than others, and it remains yet for the experiment station to ascertain which one will affect the wool the most favorably. G. E. W.

Immigration in 1899.

The total arrivals for the year ending June 30, 1899, were 311,715, an increase of 82,416 or 36 per cent. Of the total arrivals Europe furnished 297,349; Asia 8,972; Africa 51. In all other countries, 5,343. There were 195,277 males and 116,438 females. According to age, 43,983 were under fourteen years; 248,187 were from fourteen to forty-five and 19,545 were forty-five years or older. As to illiteracy, 60,446 could neither read nor write, and 1,022 could read, but were unable to write. The total amount of money which they exhibited to the officers was $5,414,462; 174,618 had less than $30 each.

Census Inquiry Regarding Canals.

The prompt and careful responses to the recent request by the Director of the Census, for information relating to canals and ditches, indicate that the importance and value of a complete and accurate census of irrigation are appreciated by those engaged in this branch of agriculture.

Director Merriam is very well pleased with the great interest evinced in the work of collecting data, and is confident that with the continued assistance of the irrigators and the press, the present investigation will be a success.

The returns from the preliminary inquiries furnish evidence of the material progress made in arid America and give promise of an advance in the twentieth century exceeding the wonderful development of the Mississippi Valley during the past decade. The boundary line, which so long has divided the arid and humid regions, will no longer stay the onward march of agriculture. To-day it is realized that just beyond that line lies an empire greater and far more resourceful than any yet conquered. With the narrowing of the unoccupied limits of government lands in the humid zones the question of reclaiming the arid and subhumid regions grows in importance, and is to-day claiming the attention of the wisest minds of the nation.

Many of the preliminary schedules sent out in December and January have been received and are already tabulated. The mailing of the principal schedules is being pushed as rapidly as possible.

The questions in this schedule are numerous and important. Director Merriam requests that they be carefully answered, as upon these answers an accurate and perfect census of irrigation largely depends.

The scope of the present inquiry is broad. Its purpose is to determine the present conditions and results of irrigation, and to tabulate the same in such a manner that they may be fully comprehended by every one. Such a work successfully conducted, will result in bringing about a more complete realization of the fact that the development of irrigation is affecting the prosperity of our nation as well as the progress and stability of many Western States.

Geography and Exploration in 1899.

No great geographical discoveries have been recorded during 1899, but a great deal of exploration work has been accomplished. Considerable interest has been taken in preparing expeditions of Antarctic research, of which the Belgian expedition has returned with some important results. Mr. Borchgrevink has begun his work at Cape Adar on the Antarctic mainland. The search for Andrée has helped to increase our knowledge of parts of the Arctic coast, says Popular Science Monthly. In Asia, Captain Deasy has laid down the whole of the course of the Yarkand River, which was before unknown.

The expeditions sent out by Canadian surveys are constantly opening up new country and the maps produced are of great value. Mr. A. P. Low, finds Labrador to be a country less bleak and hopeless than has been generally believed. Sir William Martin Conway has done some very creditable explorations in the Andes and in Tierra del Fuego the scientific results of which are of considerable value. In Chili, Dr. Staffer and his colleagues have explored the wonderful fiords of the coast and rivers which came down to them from the Andean range. Dr. Moreno has described the results of twenty-five years' exploration of the great Patagonian plains, and the readers of the SCIENTIFIC AMERICAN will remember the article which was recently published on Prof. J. B. Hatcher's explorations in Patagonia. One of the most important scientific enterprises was the German oceanographical expedition in the Valdivia under Prof. Chum, which went south through the Atlantic to the edge of the Antarctic ice and north through the Indian Ocean to Sumatra, and home through the Red Sea.

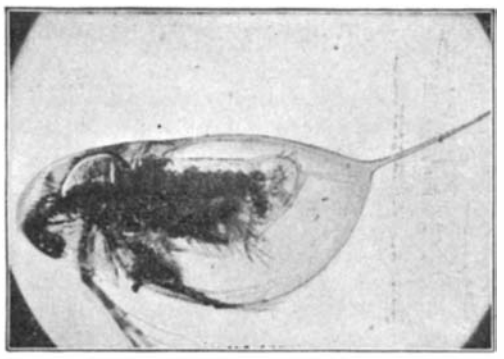
Old Stage Effects.

We are apt to consider that stage effects are an invention of the present century. This may be so in some cases, but many of them are very old. The limelight is probably the most valuable accessory for modern stage effects. It was introduced some time around 1837 or 1838, and was regarded as a great curiosity. Its expense, however, prevented its being used to any extent for a long period. In 1480, intricate machinery was regularly used in religious plays for the simulation of various natural phenomena. Earthquakes always seem to have been the most pleasing and taking of effects, and we hear of them as far back as 1692, when Evelyn refers to a puppet show in which an earthquake effect was used. The old paper snow for winter effects was largely abandoned, and in France waste clippings of glove manufacturers are used instead. The white glove clippings fall better in the air than small pieces of paper, and they cling better to the scenery and to the actor's garments as they descend. The ordinary nautical effects are of considerable antiquity. Full-rigged ships were in use in Paris as far back as 1713.

A NEW APPARATUS FOR INSTANTANEOUS PHOTO-MICROGRAPHY.

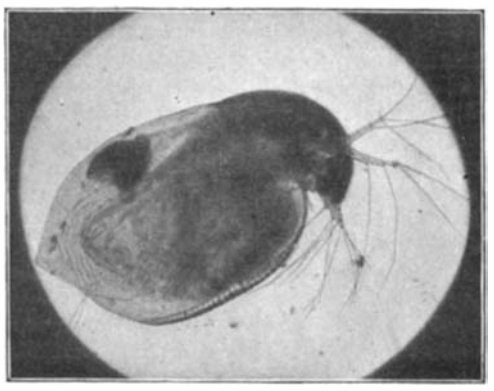
BY PROF. A. C. SCOTT.

The subject of photo-micrography is alike important to both biological and physical science. It involves not only accurate and interesting work with micro-



COPEPOD, 200 DIAMETERS, 1-35 SECOND EXPOSURE.

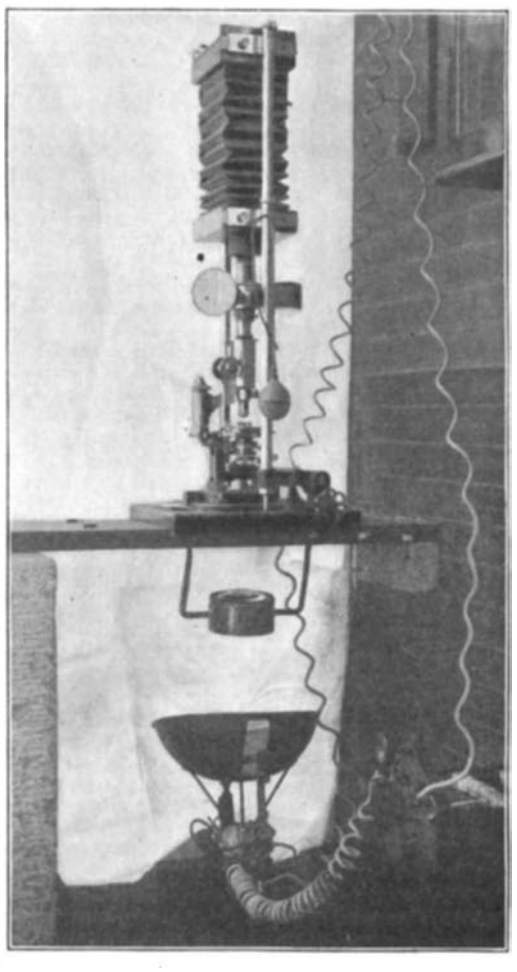
scopic organisms, but from the physical which includes the photographic side, much care is required in the selection and manipulation of the proper microscopic lenses, in connection with the source of light employed, stain used upon the subject to be photographed, if a mounted slide, and the chemistry necessarily connected



COPEPOD, 250 DIAMETERS, 1-40 SECOND EXPOSURE.

with the handling of the photographic plate itself, in order to obtain the best results.

The different general methods employed in this work together with proper magnification for certain forms, kind of illuminant, with ray filters, exposure, and character of plate, require separate treatment, as the chief



APPARATUS FOR INSTANTANEOUS PHOTO-MICROGRAPHY.

object of this article is to describe a new apparatus for making instantaneous photographs of living microscopic animals.

After having worked upon photo-micography for some time for the purpose of obtaining photographs of microscopic slides for illustration with the optical lantern, and having determined the conditions requisite to the production of good results with mounted slides, the thought occurred to the writer that if an instantaneous photograph of a living organism could be made, it might be valuable to the biologist and instructive to the physicist.

It will at once be apparent to those who have worked along this line that a powerful light is necessasy for instantaneous work; in my own work with the apparatus an arc light consuming 2,200 watts is employed which gives, in the position used about 4,000 c. p. This light, as will be seen from the picture of the apparatus entire, is placed at a distance a little greater than the focal length of a condensing lens, so that the intensity of light upon the object and objective is considerably greater than would be the case without the lens. Of course a different position of the lens and light would magnify the intensity of the light greatly, but that is undesirable beyond a certain limit as the heat would be detrimental to the microscope objective.

With the proper arrangement of the light the essential feature in making the instantaneous photographs shown herewith is the combination shutter and view tube which is made to be clamped by means of three thumb screws to the draw tube of the microscope. This apparatus is fastened on after the ocular has been inserted in the draw tube. The mechanism of the apparatus is as follows:

Upon a movable brass plate inside a light tight box, (shown in Fig. 1, just below the camera bellows) is a 90-degree prism mounted in such a way that all of the light which passes through the microscope is projected upon a piece of ground glass at the end of a cone, which may be lengthened or shortened in order to give correct focus to the object here, when it is properly focused upon the ground glass of the camera directly above the microscope. Next to the prism is a hole in the brass plate for allowing light to pass from the microscope directly to the photographic plate when the prism is moved by means of a spring and pneumatic release, and finally a sufficient amount of the solid brass left to cover the opening when exposure has been made.

To take a photograph the microscopic animal is placed in a drop of water upon a suitable glass plate, the light is turned on and the shutter so set that the object may be focused upon the ground glass of the cone. The plate holder is inserted and the dark slide drawn leaving the plate exposed inside the camera bellows. The movements of the animal are easily seen upon the ground glass and when the desired position is obtained the shutter is released, the prism moves out of the way, aud the light passes to the plate. Cramer's isochromatic plates have given the best satisfaction with this instantaneous work. Although the apparatus is not perfected to the writer's complete satisfaction, exposures as short as $\frac{1}{40}$ of a second have been very satisfactory. Neither of the negatives whose prints are shown with this article had more than $\frac{1}{35}$ of a secend exposure. It seems perfectly possible with good microscope objectives and the best arrangement of illuminant to obtain thoroughly satisfactory negatives in $\frac{1}{100}$ of a second.

The apparatus may be of some value other than photographic to biologists from the fact that it allows one to study the movements of a living microscopic organism with both eyes with perfect ease instead of by the common one-eye method which is apt to be tiresome.

The Water System of Pompeii.

Pompeii, like most Roman cities, had an excellent water system, but we are able to judge of the systems in other places only by the small remains, but in Pompeii, the whole system has been laid bare, and in "Pompeii, Its Life and Art," by August Mau, translated by Prof. Francis W. Kelsey, there is an interesting description of the water supply of the city. Remains of the great aqueduct near Avellino, a dozen miles east of Nola, have been discovered, and this aqueduct followed the base of Vesuvius and furnished water to Naples, Puteoli, Baiae and Misenum, but the source from which Pompeii received its water supply has not been discovered. The construction of the older baths showed that a free use of water was contemplated. There were many fountains along the streets, most of them at the corners. They were filled by pipes connected with the water system of that city, and these fountains bear witness to long use by depressions which have been worn in the stone by the hands of those who leaned forward to drink. Water towers were found at the sides of streets, they were small pillars of masonry which were raised to the height of 20 feet. There was a small reservoir of water on the top, presumably of metal. In all the houses of any size and importance there were flowing jets. Thus, in the famous house of the Vettii which was discovered a few years ago there are no less than sixteen jets, and water was not stinted in any of the three baths which have been discovered. The water-pipes were made of sheet lead folded together, the transver sesection somewhat resembling that of a pear. Their size was regulated by the pressure and the water was turned on and off by stop-cocks which were much like those in use to-day.

Trinity House, London.

On Tower Hill, London, near the mint is "Trinity House," a corporation for the increase and encouragement of navigation, the examination of pilots, the regulation of lighthouses and buoys and, indeed, all naval matters not under the express jurisdiction of the Admiralty.

This corporation has a most curious and interesting history, and it has large powers which in this country are vested in the Treasury Department. Trinity House was founded by Sir Thomas Spert, Comptroller of the Navy to Henry VIII. It was incorporated in 1529 by the name of "The Master Wardens and Assistants of the Guild, or Fraternity of the Most Glorious and Undividable Trinity of St. Clement in the Parish of Deptford Stroud, in the County of Kent," and the parent establishment which was pulled down in 1787 was built at Deptford. In 1680, its first lighthouse was erected. Formerly all the lighthouses on the English coast had been built by private individuals under a patent from the crown. Indeed, it was not until 1854 that the private rights in the lightdues were abolishd and the exclusive right of lighting and buoying the coast given to the Trinity Board. Among their other duties are to bind and enroll apprentices to the sea, examine the mathematical boys of Christ's Hospital, examine the mathematical masters for the navy and place or alter all the buoys, beacons and sea marks along the English coast, also for the channel of the Thames and other ports. To them also once belonged the power of ballasting all ships going out of the Thames, the ballast to be taken from the more dangerous shoals and where the river needed deepening, and at request masters of ships they could also certify that goods had been badly stowed. They could also prevent foreigners from serving on board British ships without licenses. They heard and determined complaints by officers and men in the merchant service and they could punish seamen for mutiny and desertion. Like all old institutions of this kind there were many curious by-laws. Thus, every master homeward bound was to unshot his guns at Gravesend under penalty of a fine of twenty nobles.

The corporation consists of a master, deputy masters, thirty-one elder brethern and an unlimited number of humbler members. The elder brothers are generally selected from old commanders in the navy and merchant service, and now and then a compliment is paid to a prince or a nobleman by his selection, although as Walter Thornbury aptly remarks, "they could not steer a collier to Newcastle." The revenues of the corporation are very large. A number of years ago they amounted to $1,500,000, and they probably now much exceed this sum. They are obtained from tonnage dues, ballastage, beaconage, and licensing pilots, and this sum after defraying the expenses of the lighthouses and paying off the portion of debt incurred by the purchase of all existing private rights and lighthouses, is chiefly expended in maintaining poor disabled seamen and their widows and orphans by pensions in the corporation hospital at Deptford, Stroud, which the masters and brethern visit in their state yacht in grand processions on Trinity Monday. The powers of Trinity House in old times were much greater than at present and they decided many maritime cases which were referred to them by the Admiralty judges. Some of their regulations now appear to be ridiculous. At one time every mariner who swore, cursed, or blasphemed on board ship, was by their rules compelled to pay one shilling to the ship's poor box; no mariner, unless sick, could absent himself from prayers without forfeiting six pence. The building contains many interesting memorials. It is of the Ionic order and was built in 1793–95 by Samuel Wyatt. The interior contains busts and portraits. The museum contains a flag taken from the Spanish Armada by Sir Francis Drake.

Objection to Wire Nails.

Strange to say the industry of making cut nails from iron and steel is having a great revival. The introduction of steel wire nails made great inroads upon the cut nail business, but now the latter shops are adding new machinery and enlarging their facilities. The increased demand is caused by the fact that shingles that have been fastened on barn roofs for the past ten years with wire nails are blowing off and farmers are greatly exercised over the matter.

The shingles fastened with the old cut nail remained on the roof until the shingles rotted, whereas with the steel wire nail, the shingle blows off after ten years. The main trouble with the steel wire nail, says The Evening Post, is that it cannot stand the weather as the wrought iron nail does. This is partly caused by the acid used in annealing the wire before it is drawn which cannot be thoroughly cleansed off. The Watervliet Arsenal experiments show that cut nails have proved to be 50 per cent more adhesive when driven into wood than wire nails, but the bright and cheaper wire nails soon succeeded in making a great difference in the cut nail trade. The carpenter can drive wire nails too handily to return to the cut nails unless specifications actually require it, and the demands for cut nails are coming largely from agricultural sections. A big steel wire combine has had a special nail made with an extraordinarily large head and galvanized all over. These are guaranteed to outlast any nail in existence.

A Vitrified Clay Church.

A new church at Chicago, is built exclusively of vitrified clay, even the window frames are of the same material. The decorative features are white terra cotta. The altars, communion rail, pulpit and front of organ loft are all terra cotta. The entire ceiling is of brick and tile vaulting, the keystones being of terra cotta and the ribs of the arches and groins of molded brick. There is not an inch of timber or a nail in the entire structure. Its acoustic properties are said to be remarkable.

The Current Supplement.

The current SUPPLEMENT No. 1264 is a most interesting issue. The "Prehistoric Ruins of Copan," is an elaborately illustrated article showing views of the site and the various finds. Some of the most important archæological work which is being done in America is being carried on at Copan. "Remedies for Snake-Bites: Scientific and Empiric" by A. W. Buckland, is a most valuable scientific paper. "The Weight of Air" is an article giving a graphic representation of the subject.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HAND-RAKE.—MYLES Y. WARREN, Germantown, Philadelphia, Penn. To provide a rake arranged to discharge the gathered material from the teeth, is the purpose of this invention. The rake, with this object in view, is furnished with a cleaner movable on the teeth. A spring-lever is fulcrumed on the rake and engages the cleaner to move it up or down on the rake teeth. The spring-lever can be locked to hold the cleaner in an uppermost position.

SICKLE-BAR ADJUSTER. — MARTIN ANFINSON, Vermilion, S. D. This invention relates to a means for mounting the sickle-bar or cutting apparatus of a mower, so that these parts can be adjusted forward or backward to take up the wear on the pivots connecting the cutting-apparatus with the frame of the mower. On a coupling-arm an eccentric sleeve is mounted to roll. A bearing is mounted loosely on the sleeve and is provided with cutting apparatus. By rolling the eccentric sleeve, the bearing, and consequently the sickle and finger bars, can be adjusted forward or backward.

Electrical Apparatus.

TELEGRAPH-SOUNDER. — SAMUEL F. LIVELY, Alderson, W. Va. The device patented by the inventor is a double sounder, in which the two sounds are alike in tone or pitch, thus rendering the sounder distinct and clear. A pole-changer is provided, whereby the direction of the current-flow can be changed at will, thus enabling the operator to use the end of the lever for the downward stroke which happens to be the heavier. There is no spring resistance to be overcome, as in similar devices. The sounder automatically conforms to the fluctuations of the battery strength.

Railway-Appliances.

CAR-REPLACER.—JOHN C. BATES, Gilman, Colo. The purpose of the invention is to provide a simple, portable device, whereby a derailed car can be quickly directed to the rails of the track. The device is so constructed that the replacers can be turned end for end and interchangeably used, and that the wheels of a car can be conducted from the surface of the ground to a proper position upon the rails with the least possible resistance.

RAILWAY.—SANFORD P. DICKINSON and JOHN A. ROGERS, Corning, N. Y. In this railway the rails are mounted on continuous trusses, in turn supported by cross-ties formed with webs and base flanges, the cross-ties and trusses having certain peculiar features of construction by which the rails are more effectively mounted and secured than in the construction at present in use. The cross-ties comprise vertically-extended webs and horizontal base-flanges, the former having recesses formed in their upper edges. The trusses are horizontally set into the recesses and are provided with grooves in their upper faces. The rails have their base-flanges set in the grooves. Tie plates bear down on the base-flanges and are secured to the trusses.

Engineering-Improvements.

SALES AND CASH REGISTER.—CARL J. D. WALTER and JOHN RODGERS, Manhattan, New York city. The register is especially designed to be used in stores, and is arranged to enable a salesman to record a sale and the amonnt of cash received and placed in the till. The record is made upon a paper strip wound from one reel to another, and is reproduced upon an underlying strip wound off from an auxiliary set of reels. A full record of the sales is made so that the owner of the store can ascertain the day's sales; and the total amount stated on the paper must correspond with the amount in the cash drawer. A device is provided to prevent the unauthorized opening of the till.

LEMON-SQUEEZER.—JOHN L. EASLEY, Manhattan, New York city. The squeezer is of the class in which a juice-extracting cone is employed and a receptacle for the juice. One object of the invention is to assure a more thorough separation of the seed and pulp from the juice than has been heretofore possible with such squeezers, and another object is to so construct the squeezer that it can be held in the hand while in use or placed upon a support if it be so desired.

GARMENT. — LAURA H. JOHNSON, Battle Creek, Mich. The invention provides a bust-support entirely free from stiffening devices, such as bones or steels, leaving the body of the wearer free from the constriction usually produced by belts or bands surrounding the body.

LID FOR COOKING UTENSILS. — JAMES H. SWIFT, Punta Gorda, Fla. The lid is swinging and detachable, especially applicable to saucepans, pots, and kettles, and so made that it can be horizontally swung upon a pivot serving as a handle, and that it can be lifted entirely from the body of the receptacles. The lid can be entirely removed from the vessel, and the pivot of the lid can be placed at either side of the vessel, enabling the lid to be swung to the right or to the left.

COAL OR FREIGHT RUN.—JOHN BRADY, Manhattan, New York city. The runway comprises an upper track and a lower track. A scale-platform, forming a portion of one of the tracks, is balanced to be upset by a given weight. A locking device is arranged to hold the scale-platform when desired in a fixed position. Elevator-cars travel in shafts extending from the upper to the lower tracks, each car being provided with rails capable of constituting sections of the lower track and with tracks at its sides at an elevation from the bottom. A receiver for weights is connected with the scale-platform, whereby the number of pounds placed on the platform in excess of the amount which the platform is designed to balance can be ascertained.

METHOD OF PRODUCING ORNAMENTAL FABRICS.—MARK H. FRANK, Manhattan, New York city. This invention is an improvement in methods for producing ornamented fabrics by placing embroidery and lacework thereon. The pattern for both the embroidery and lacework is stamped directly upon the base or body fabric. The lacework is then formed in the usual manner upon the surface of the fabric, whereupon the embroidery is directly worked so as to include the lacework and that portion of the base or body fabric within the lines of the embroidery-pattern.

RATCHET SCREW-DRIVER. — GEORGE E. GAY, Augusta, Me. Two pawl-members are loosely mounted on the blade and spring-pressed toward the ratchet-disk. A ferrule forms part of the handle and surrounds the disk and pawl members. The ferrule has a longitudinal slot; and each pawl-member has an arm extending through the slot. A ring, frictionally held on the ferrule, is adapted to engage with either arm, the ring being in width less than the distance between the two arms in their locked position, whereby the device may be used as an ordinary screw-driver.

WIRE-HANGER.—JAMES W. L. JAQUES, Salt Lake City, Utah. The object of the invention is to provide a hanger which can be applied to hold a wire firmly without bending and moved along the wire when desired. In a casing open at its top and ends clamping-blocks are movable in opposite directions to engage the wire. A wedge-block moves the clamping-blocks outwardly.

CATTLE-STANCHION.—ADOLF JOOST, Kankakee, Ill. This cattle-stanchion is ingeniously constructed so that all the cattle can be quickly released at one time in case of an emergency, as for example, in case of a fire. This result is accomplished without enabling unauthorized persons to make use of the device for malicious purposes.

REFRIGERATOR. — JOHN NASH, Dayton, Wash. The refrigerator has a vertically-extending series of upwardly-extending pockets designed to receive the drippings from the ice-chamber, each pocket having a downwardly-extending lip adapted to direct the overflow from one pocket to the pocket next below. By this system, the air in the refrigerator is cooled and at the same time freed of impurities.

MOUTH-GUARD FOR BOTTLES. — CHARLES H. BOGART, Brooklyn, New York city. By means of this invention, the mouths of milk-bottles can be protected from fracture and can be identified as the product of a certain manufacturer even in the dark. A yielding band surrounds the neck of the bottle and engages the top edge of the bottle. A rigid ring is embedded in the band at the top edge, which band is of a diameter intermediate between the inner and outer diameters of the bottle's mouth. The band serves the dual purpose of protecting the bottle and serving as a means of identification.

DOOR-LATCH.—FREDERICK E. RICHARDSON, Manchester, Iowa. The door-latch comprises an integral yoke or stirrup-shaped bar, the ends of which embrace the door edge and serve as handles for the sides of the door. A locking-tooth is carried on the outer or bottom portion of the stirrup. A pivot is provided for the bar at one side of the door near its edge. A spring is mounted on the pivot and engages the stirrup to keep the locking-tooth projected. A keeper on the door-jamb is adapted to engage the tooth on the bar. The strain brought upon the latch by pressure upon the door when it is locked will in all cases be substantially lengthwise and not crosswise of the latch, as in most constructions. In consequence the latch gains in strength.

STORM-FRONT FOR BUGGIES. — ARTHUR A. PRALL, Dayton, Iowa. The storm-front comprises a frame constructed for attachment to the dashboard and adapted to extend upward beyond the dashboard and constitute a front support for a storm-curtain. This frame is provided with an opening through which the reins are passed, and with a glass window which can be closed or opened.

PIPE-CLEANER. — OTTO SPAHR, New Brighton, Richmond, New York city. The cleaner is a fixture to the mouthpiece and is of such shape that while being a conductor for the smoke, it will present scraping or cleaning edges so arranged that by turning the mouthpiece, any particles adhering to the stem will be removed. The device is of such length and shape that it will extend into the bowl without interfering materially with the communication between the bowl and the stem, enabling such communication to be kept open, and the heel in the bowl to be loosened at any time without removing the attachment from the stem.

WATER-WHEEL.—WILHO RONKAINEN, Manhattan, New York city. Each side of the wheel is made up of three concentric rings, suitably braced, and supported on the hub by four spokes. A movable boxing incloses the paddles for about one-fourth of the circumference of the wheel. This boxing is fitted with rollers, which can be made to press against the periphery of the wheel and to act as a brake. For suddenly stopping the wheel, a number of dogs are pivoted in lugs around the periphery of the boxing. The dogs engage with the teeth of a ring-shaped rack fastened around the outside edge of the blades. The boxing occupies a position at the bottom of the wheel, and the water rushing through it acts on the blades. When the wheel is stopped, the boxing is raised to the top.

SASH-BALANCE.—THOMAS M. SPINKS, Alamogordo, New Mexico. This invention does away with sash-weights and provides four separate sashes sliding in separate grooves. The two sashes which make up the ordinary top sash of a window are suspended at both ends by cords passing over small pulleys. The pair of sashes which make up the ordinary bottom sash are suspended in like manner. The pulleys from which these sashes are hung are fastened one at each end of two cords that pass over pulleys in the window-frame. By this arrangement both pairs of sashes are balanced, as well as both members of each pair, and when the window is open its widest, the sash only occupies one-fourth of the opening.

Designs.

BUCKLE-FRAME.—HENRY KNOELL, Brooklyn, New York city. The design consists of two rounded side-bars which are parallel and curve first slightly upward and then downward. They are broadened upward at one end and are connected on the upper side by a cross-piece pointed on top, with a slot at the apex, and flat across its bottom edge. They are connected on the lower side by a straight, flat, cross-piece parallel to the bottom edge of the upper one. The side-bars are joined at their other ends by a rounded cross-bar having two spaced downward projections in the center of each under side.

MENU-COVER.—MAX BECK and ROBERT O. ZIMMERMANN, Manhattan, New York city. The cover consists of a rectangular panel having a metallic-like surface, surrounding which is a narrow border having a stippled appearance, the panel being raised or in relief in relation to the border, and the edges of the panel being indented in wave-like form. Displayed within the panel are waved lines, forming a rectangular figure, at the corners and centers of which rounded projections appear.

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(7844) J. A. C. writes: I connected the Wheatstone bridge with rheostat on one side and a small piano wire about two feet long on the other. The current used was from a small storage battery of four cells. When the piano wire is plucked or bowed so that it vibrates, giving out a musical note, the needle of the galvanometer turns in a direction indicating decreased resistance in the wire. Will you please explain the cause? I was trying to prove that the wire would be warmed by vibrating, but get the opposite result. A. We have verified the statement of this correspondent, and find the same result, with a bridge sensitive to $\frac{1}{1000}$ ohm. When the wire is stretched it shows greater resistance due to its elongation, as it should. When the wire was allowed to vibrate, its behavior seemed to vary with the material. A steel wire showed a decrease of resistance while a German silver wire showed little or no perceptible alteration. Now since the temperature coefficient of German silver is very small, and that of steel is quite large, we suggest the theory that the decrease of resistance is to due cooling while vibrating.

(7845) W. M. B. asks: What will preserve gill nets (made of fine gill twine) used in catching shad in the waters of Delaware Bay? We have been using lime water as recommended, but it does not seem to have the desired effect, as the nets become rotten before one season is ended. A. The following treatment is said to preserve nets for a long time in a good condition: Soften 1 pound good glue in cold water, then dissolve it in 10 gallons of hot soft water, with ½ pound curd soap. Wash the nets in soft water, then boil them in this for two hours, press out excess of the liquid and hang up over night. The second bath consists of alum, 2 pounds; water, 5 gallons; heat nearly to boiling, and immerse the nets in this for about three hours, then press and transfer to a strong decoction of oak bark or a solution of sumac in warm water (water, 5 gallons; sumac, 8 ponnds), and let them remain immersed in this for forty-eight hours or longer, if convenient.

(7846) W. D. H. asks: 1. What is the smallest E. M. F. and current which will produce an arc? A. The counter E.M.F. of the arc is 35 volts. Hence a voltage greater than this is necessary. For direct currents at least 40 volts must be had. For alternate currents, 30 volts is the minimum. Five amperes may perhaps be taken as the minimum current. 2. I would like to produce a small arc light with the smallest possible size of dynamo, using the best and most efficient materials, and built into the most compact form; what would be the approximate size and weight of such a machine? Please give me an estimate, at least, of the size of such a machine. A. The dynamo which would light such a lamp, would require about a half horse power to drive it, and may be taken as of about the size of a half horse power motor. 3. What current is required for the manufacture of calcium-carbide at about 60 volts? A. In the electrical furnaces of the carbide works at Niagara many thousands of amperes are used. We do not know the minimum current for producing carbide. Twenty-five amperes will enable some work to be done. 4. Which is the most suitable for this, the direct or alternating? A. The direct current.

(7847) H. H. S. asks the cause producing "Jack-O-Lantern." A. The ignus fatuus is thought to be due to the spontaneous ignition of a small jet of phosphoreted hydrogen, when it comes into contact with the air. This gas is evolved by the decomposition of matter in swampy places and rises to the surface of the water where it takes fire and burns with a pale light. In the night this may be seen from quite a distance. It has always alarmed the timid and superstitious, but it is in reality a very pretty chemical experiment.

NEW BOOKS, ETC.

AMERICAN TELEPHONE PRACTICE. By Kemster B. Miller M.E. New York: American Electrician Company. 1899. 8vo. Pp. 458. Price $2.

There is quite a literature on the telephone but most of them are hopelessly out of date and the practice they stand for is archaic. The present work deals with the subject in a masterly way and tells exactly what the electrician wishes to know about switch-boards and other perplexing points in telephone work. It is an admirable book and is profusely illustrated by diagrams and half-tones taken from the objects themselves. No phase of the subject seems to be neglected.

A MODERN SAFETY BICYCLE. By H. A. Garratt. London: Whittaker & Company. New York: The Macmillan Company. 1899. 16mo. Pp. 224. Illustrations and plates. Price $1.

The literature in book form upon the bicycle is far from being extensive. The present work was intended to help riders to understand their machines and with the aid of the working drawings, mechanics can build their own machines if they desire to do so. The principles underlying the construction are clearly expressed.

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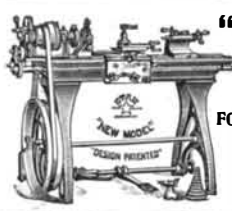
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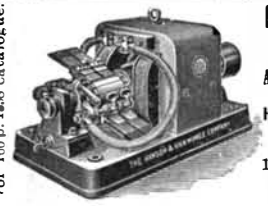
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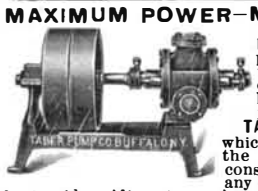
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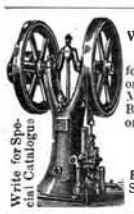

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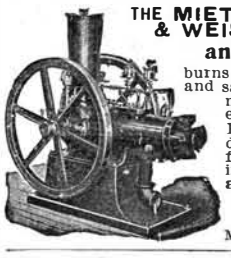

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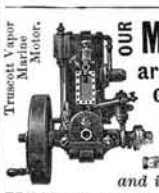

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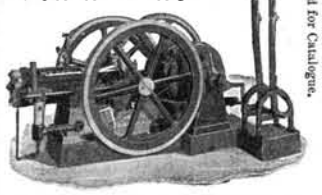

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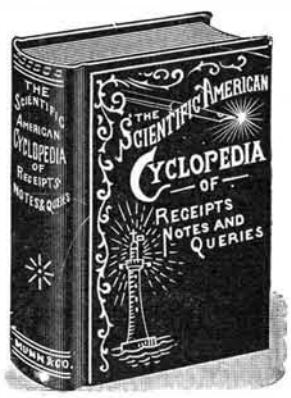

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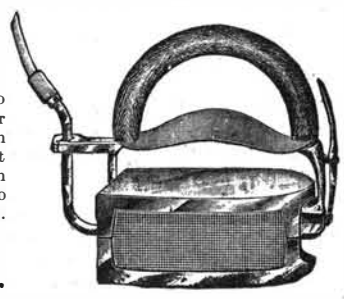

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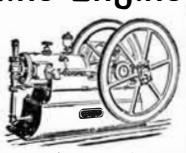

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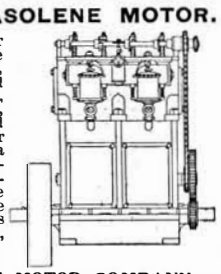

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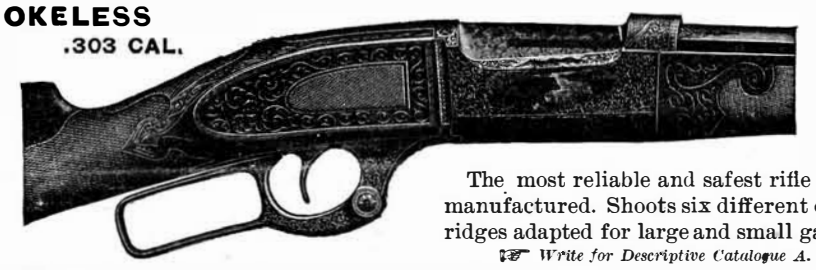

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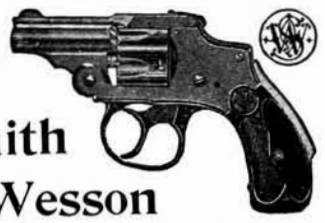

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